FIG. 1

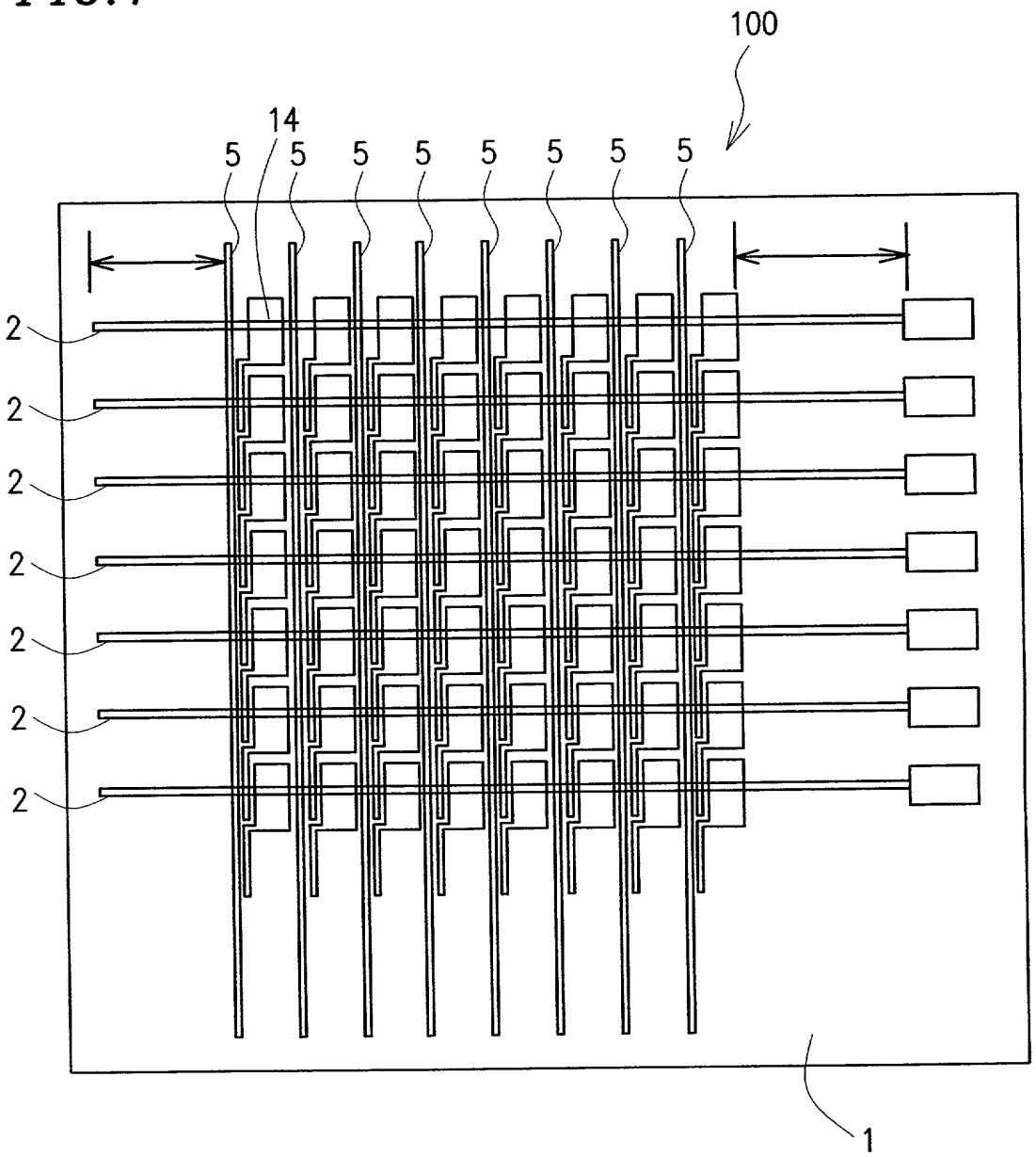


FIG. 2

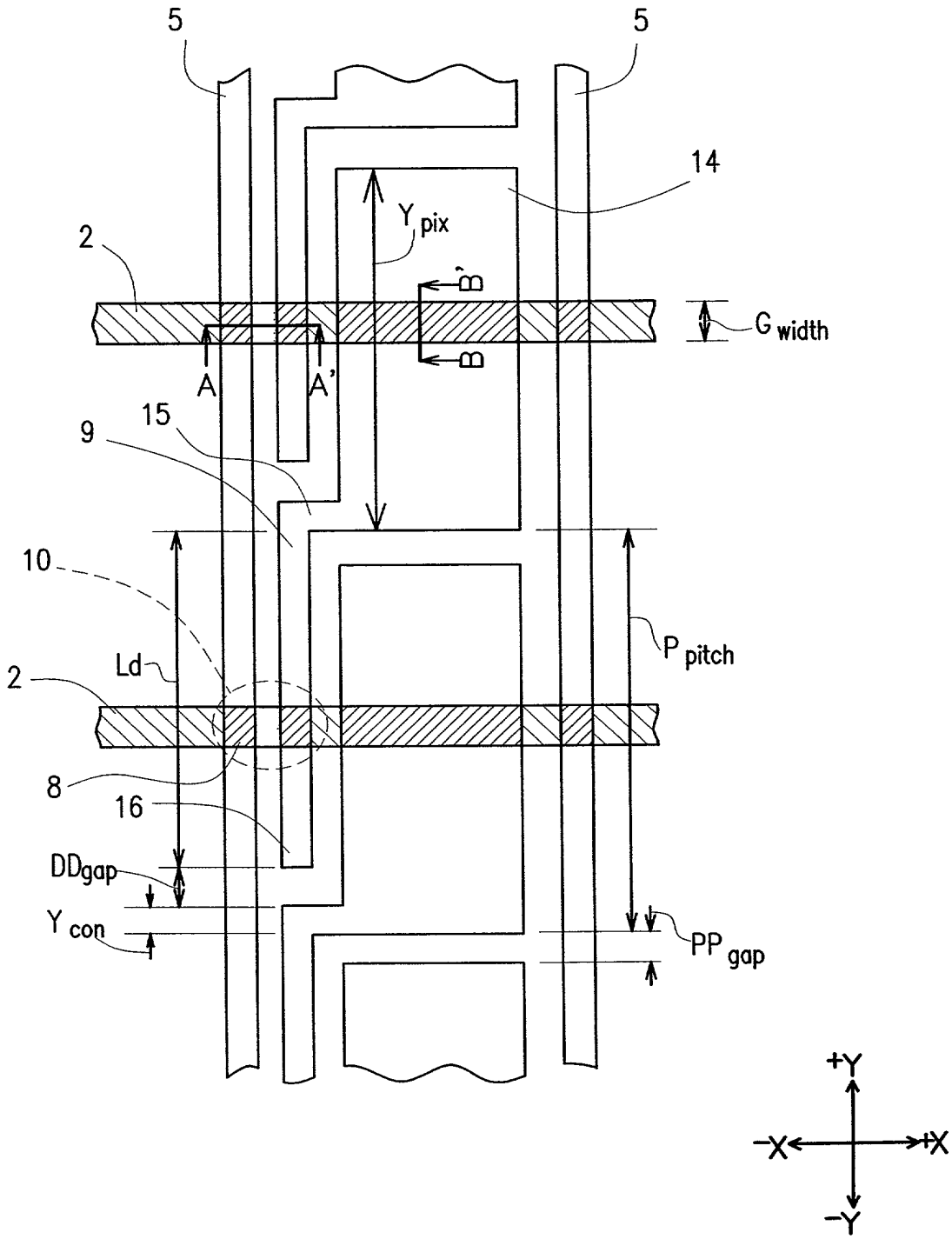

5
5
14
Y pix
2
B
B
G width
A
A'
15
9
10
P pitch
Ld
2
8
16
DDgap
Y con
PP gap
+Y
-X
+X
-Y

FIG. 3A

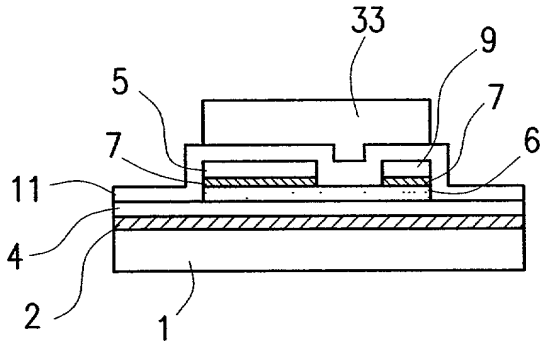


FIG. 3B

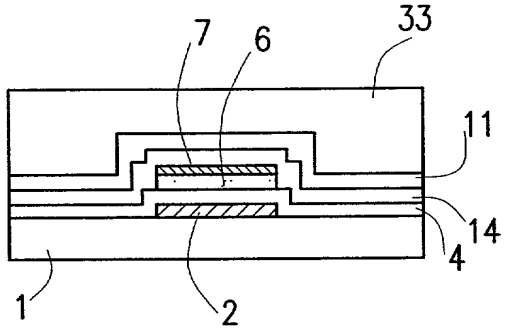


FIG. 3C

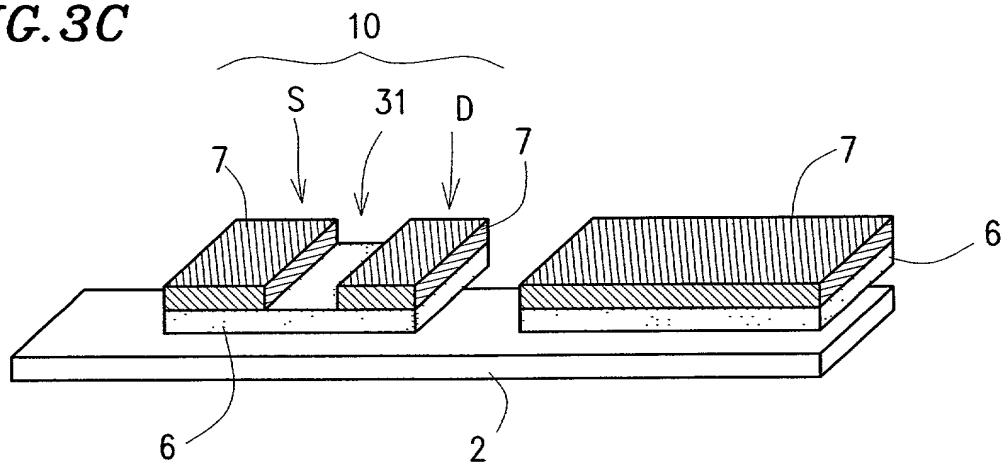


FIG. 4A

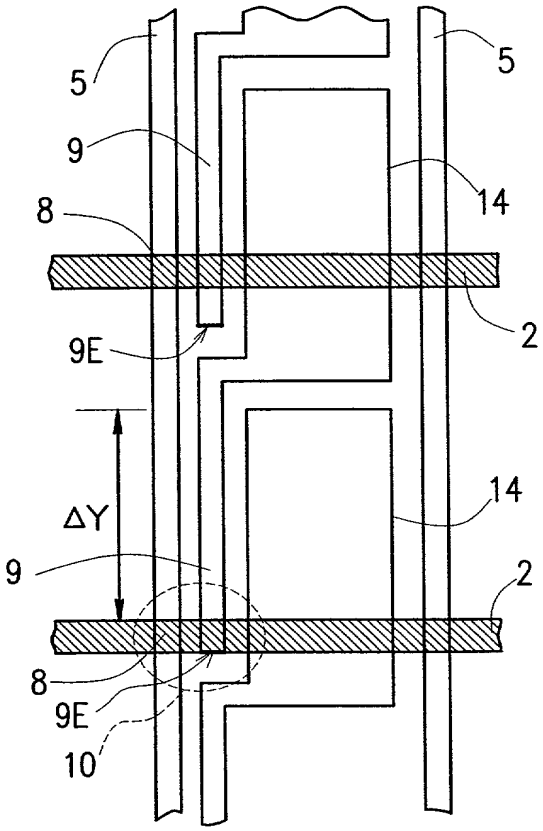
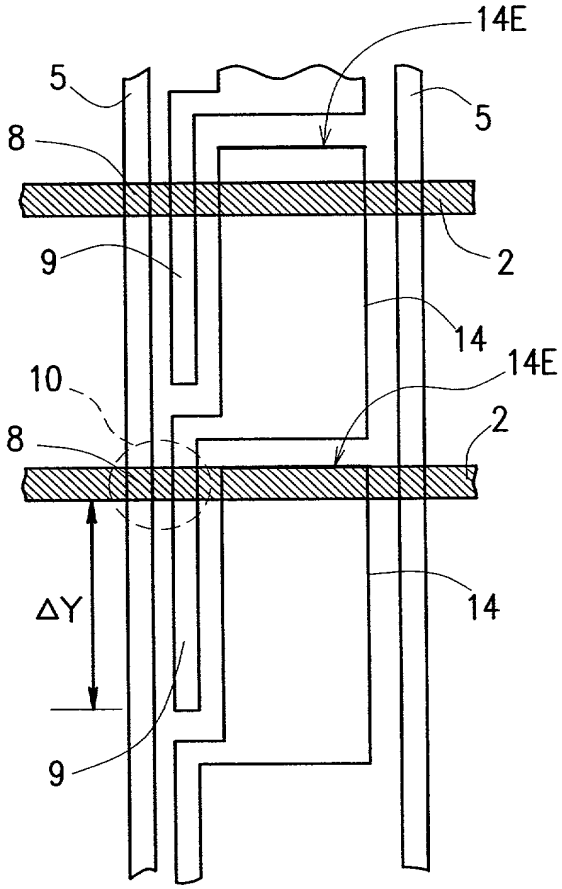


FIG. 4B



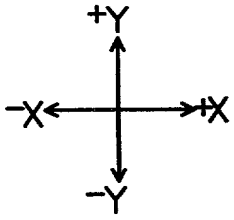


FIG.5

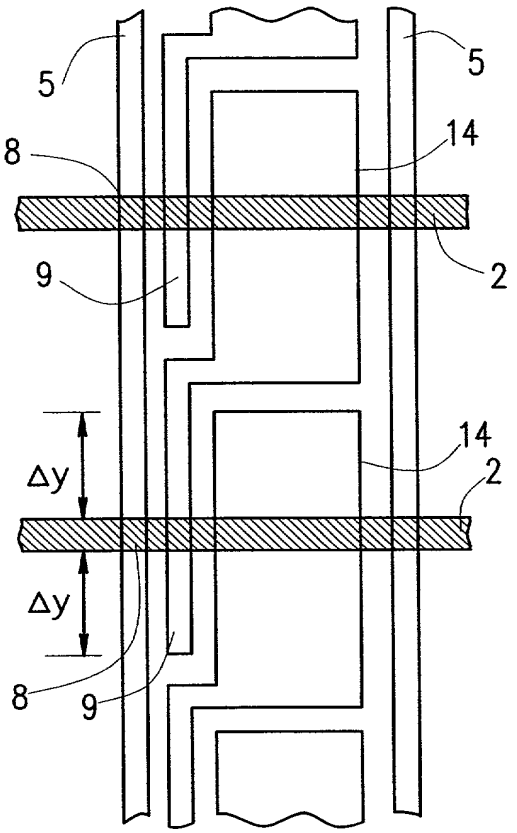


FIG. 6A

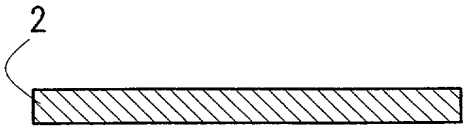
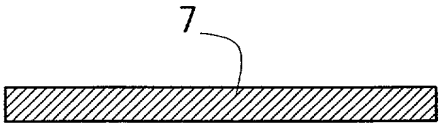
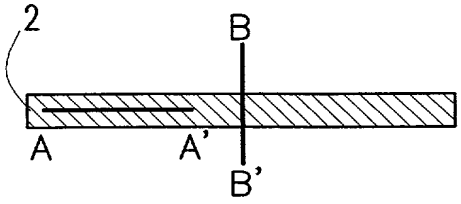


FIG. 6B





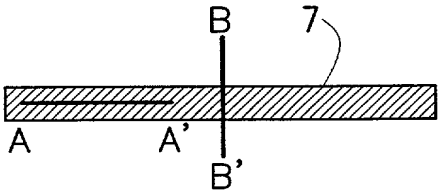


FIG. 6C

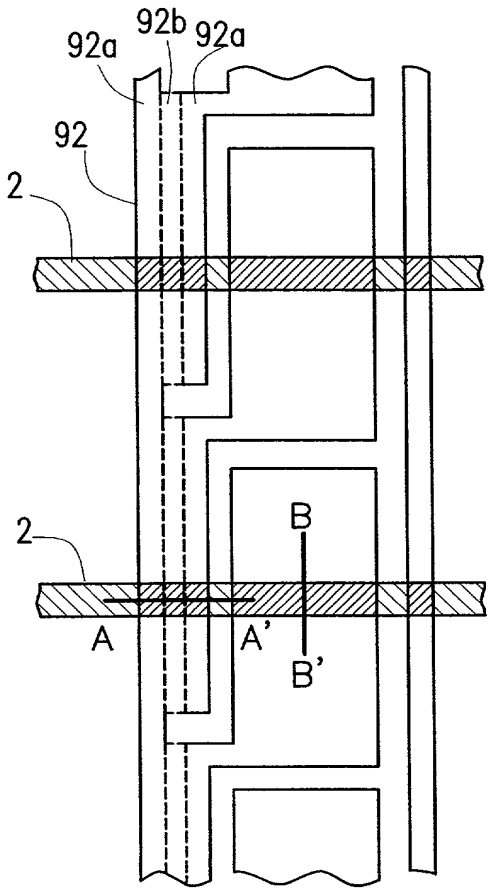


FIG. 6D

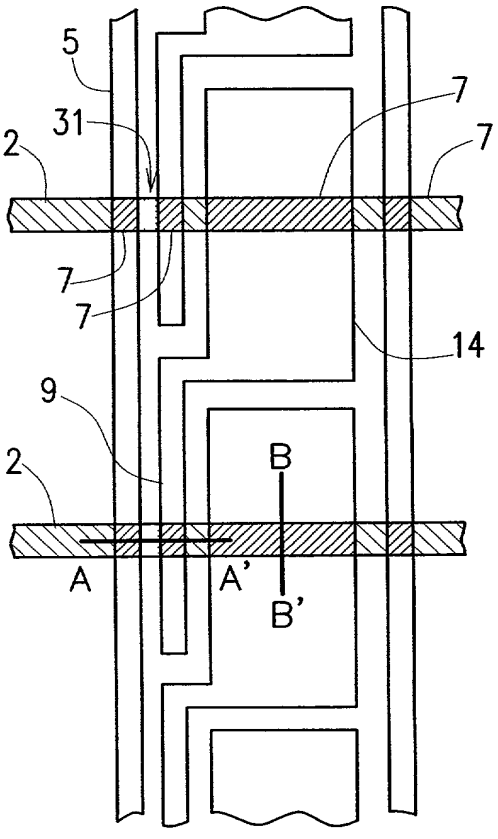


FIG. 7A

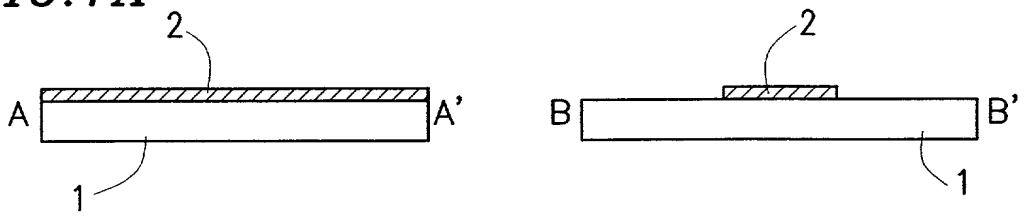


FIG. 7B

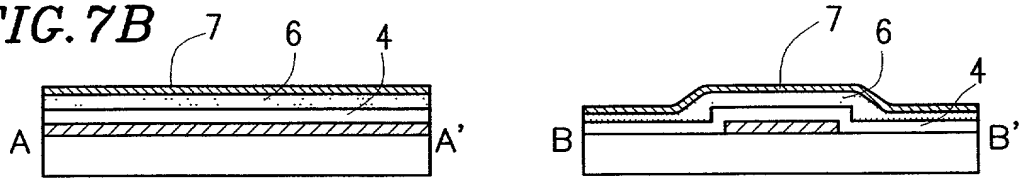


FIG. 7C

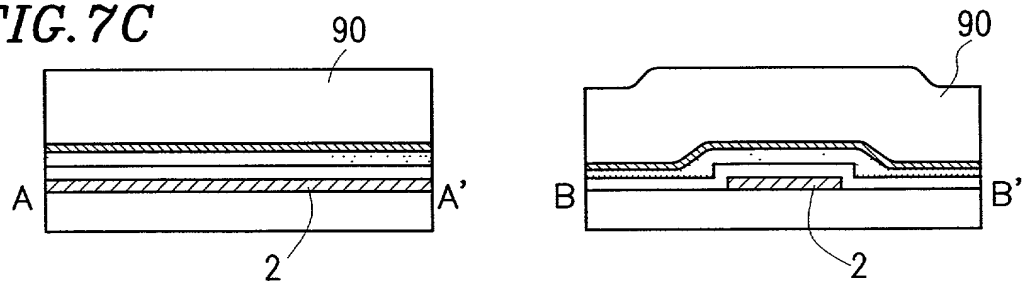


FIG. 7D

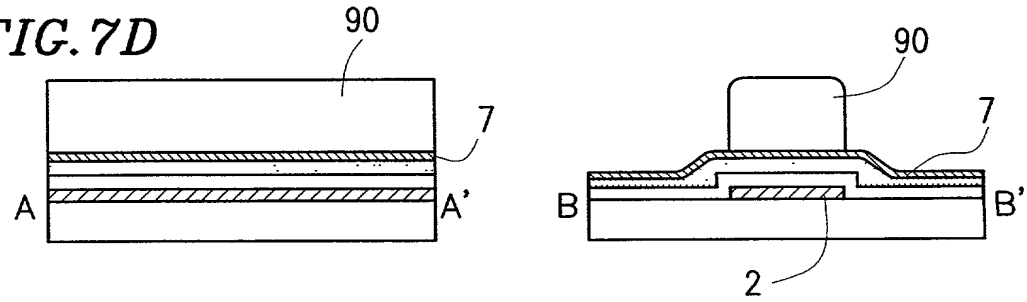


FIG. 7E

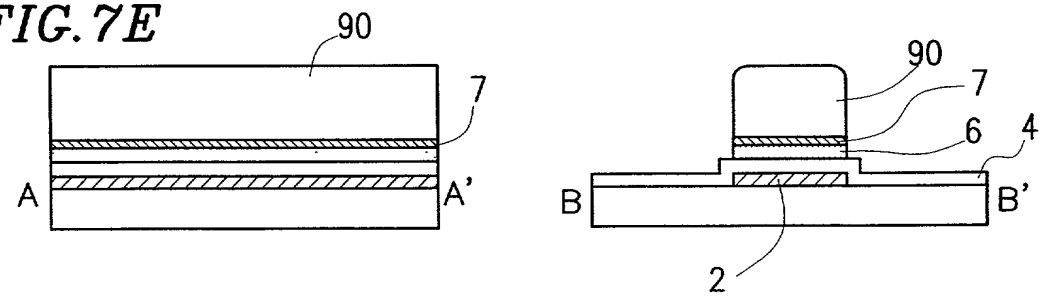


FIG. 7F

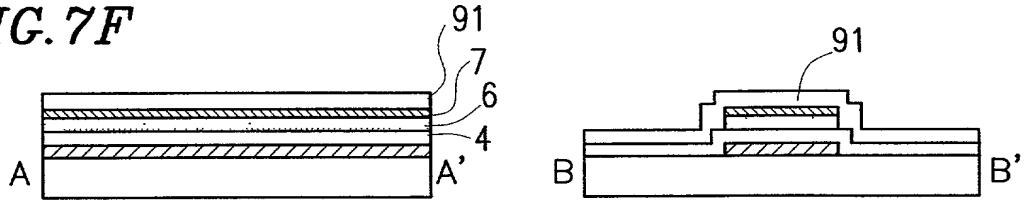


FIG. 7G

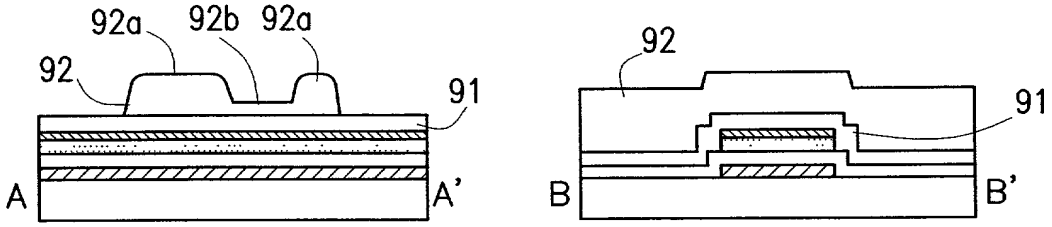


FIG. 7H

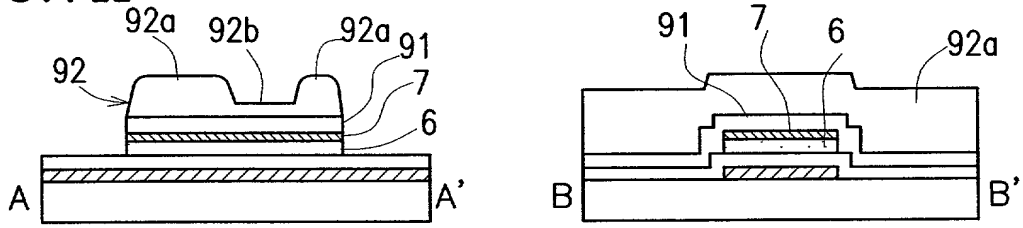


FIG. 7I

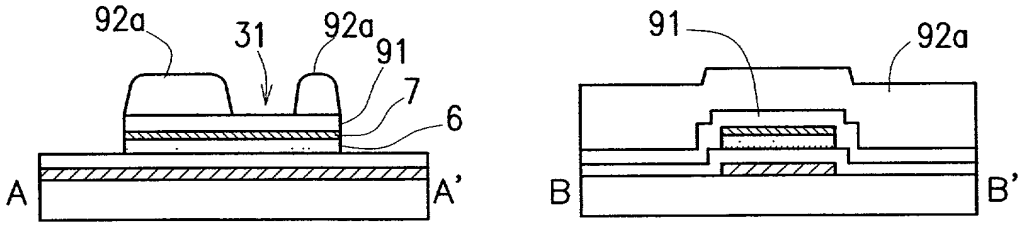


FIG. 7J

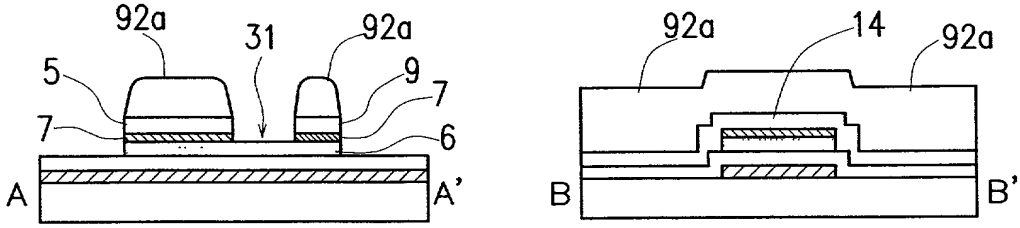


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FIG. 7K

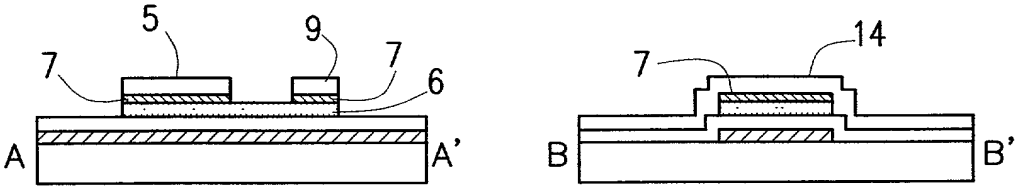

FIG. 7L

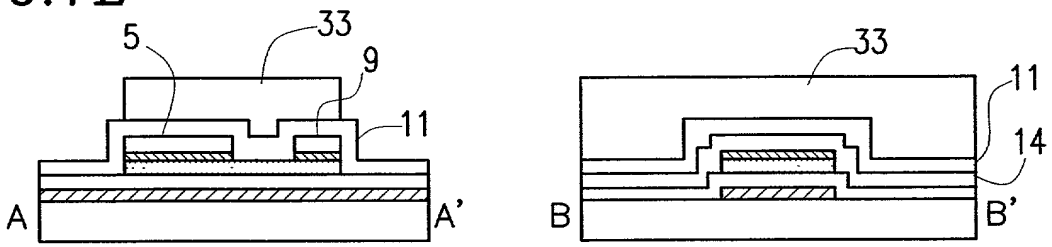

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FIG. 8A

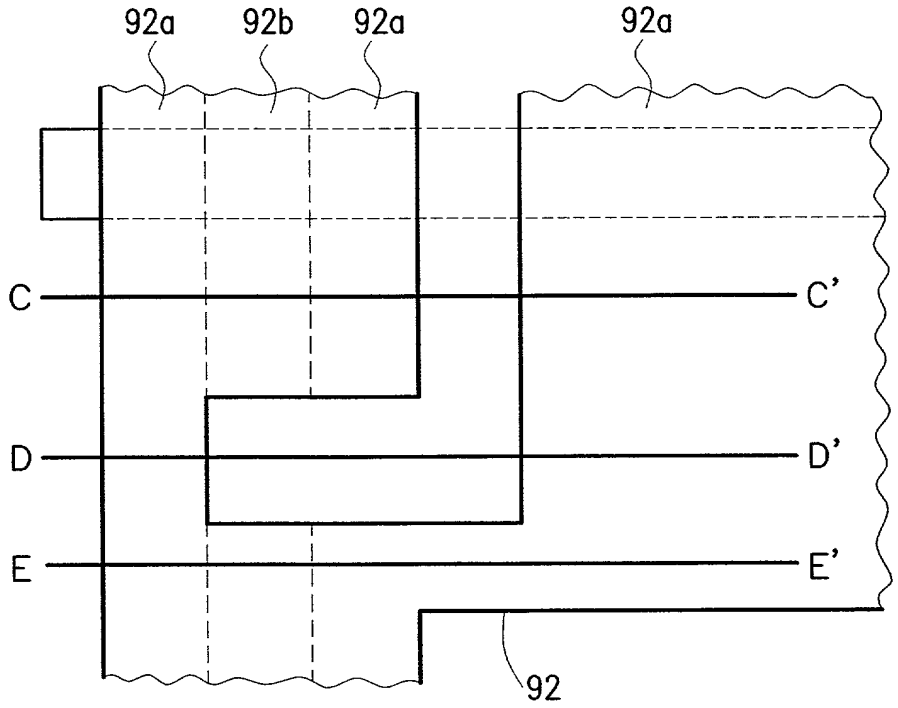

FIG. 8B

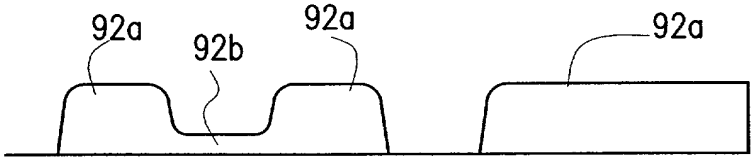

FIG. 8C

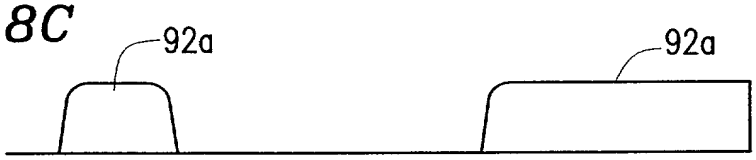

FIG. 8D

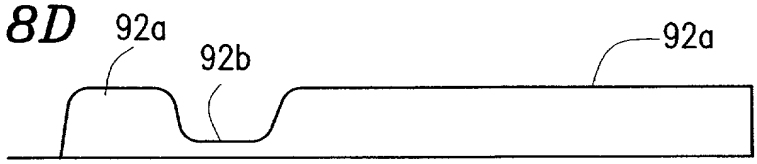

FIG. 9

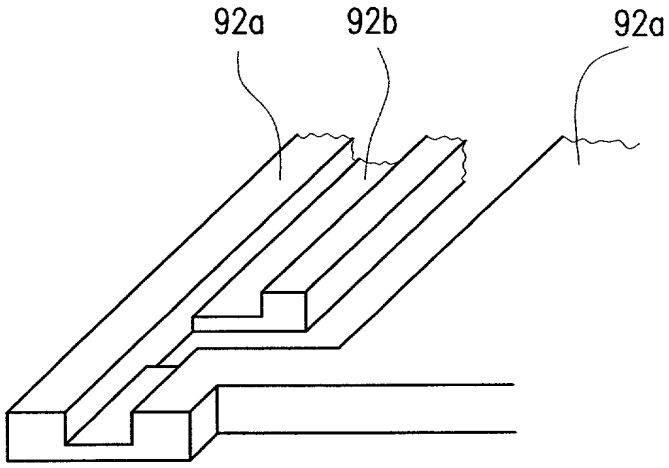

FIG. 10

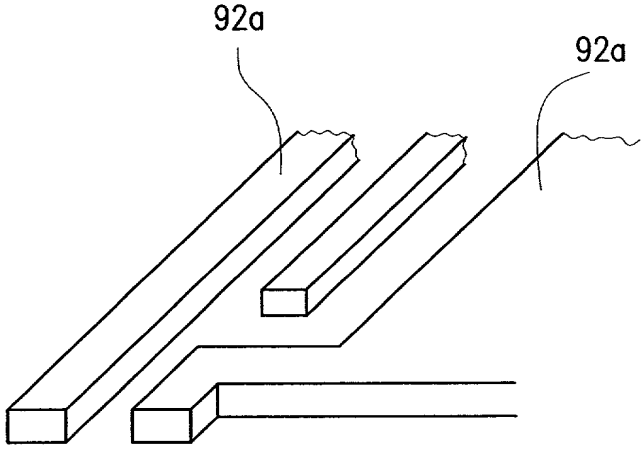

FIG. 11

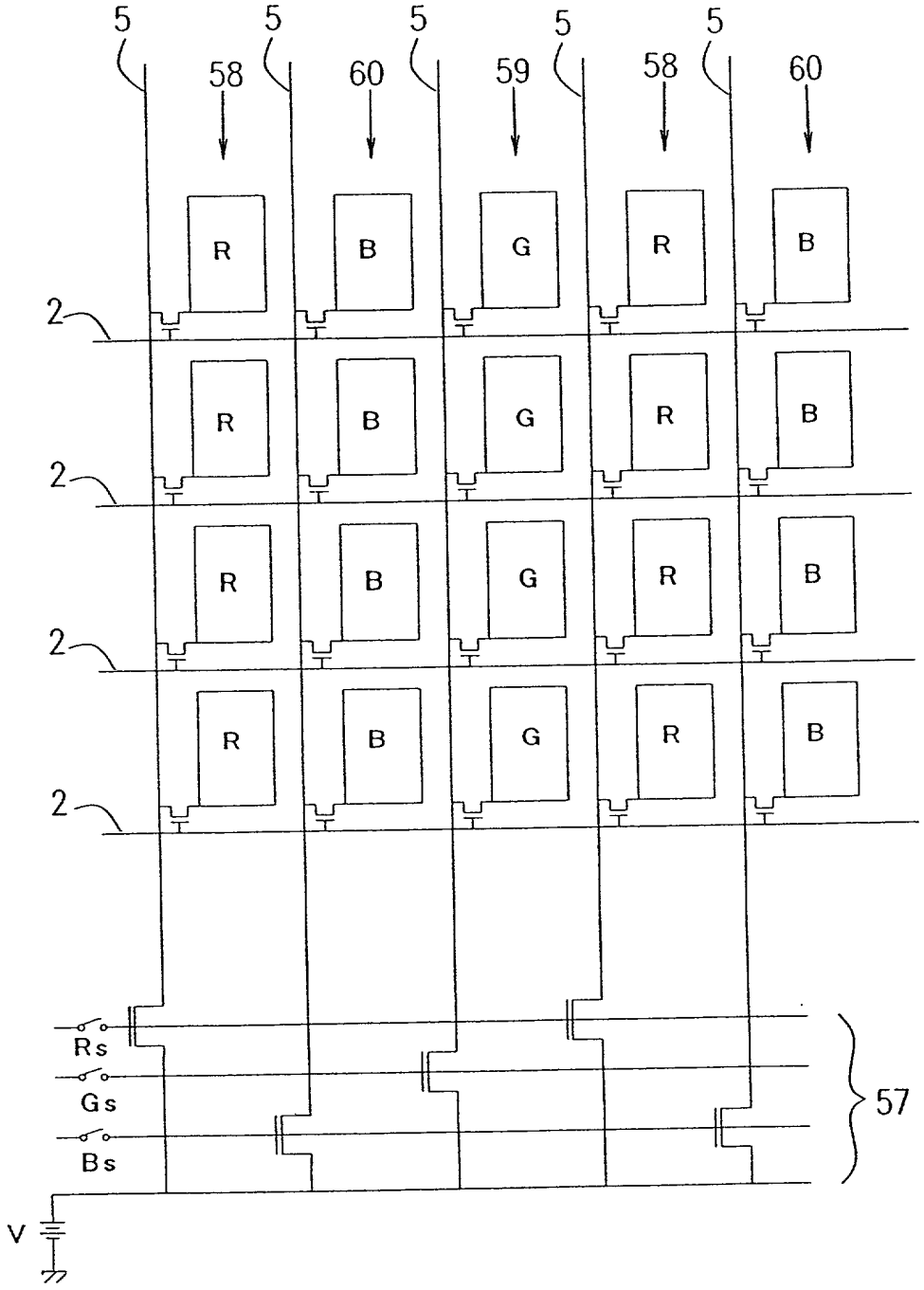

FIG. 12

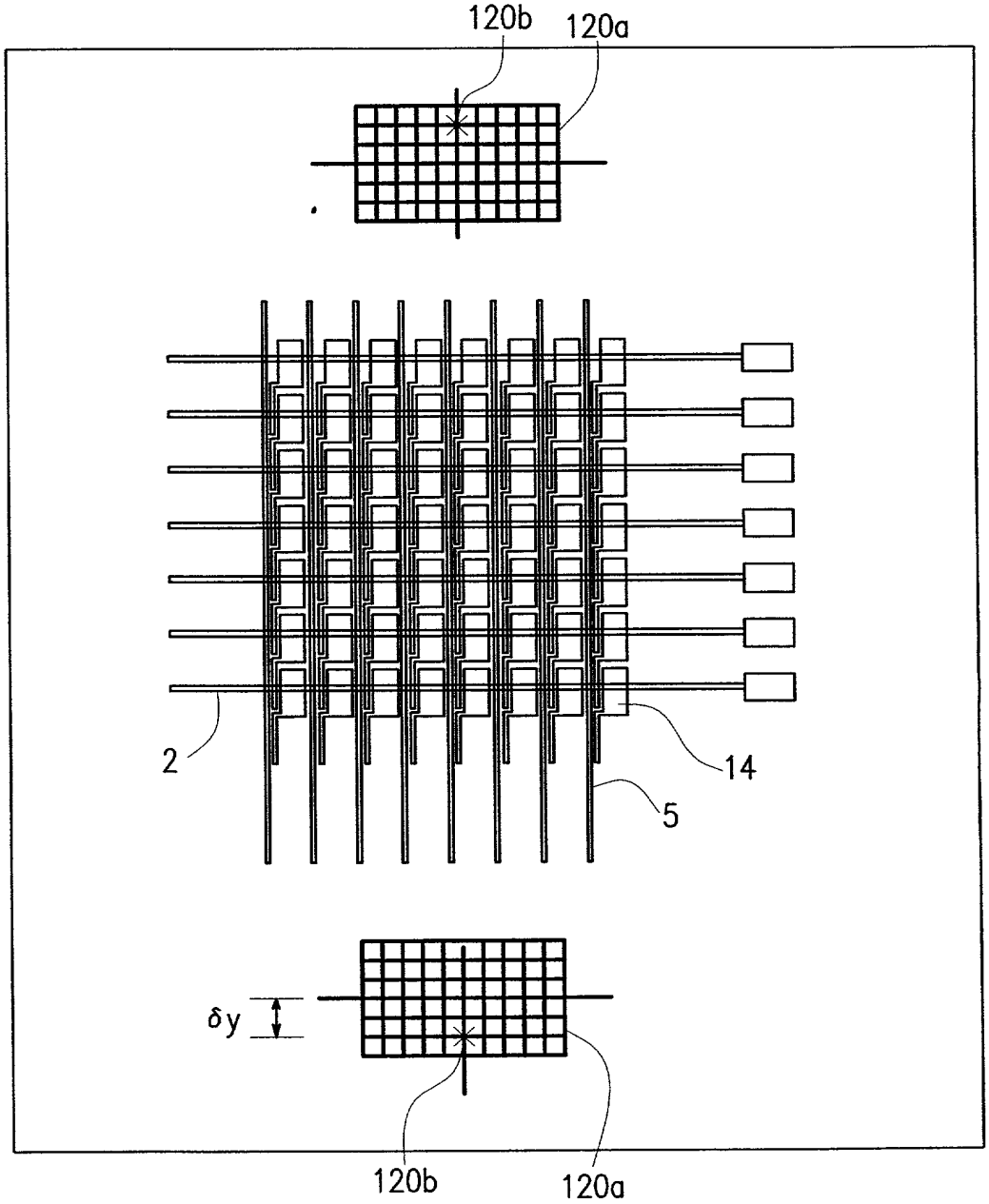

FIG.13

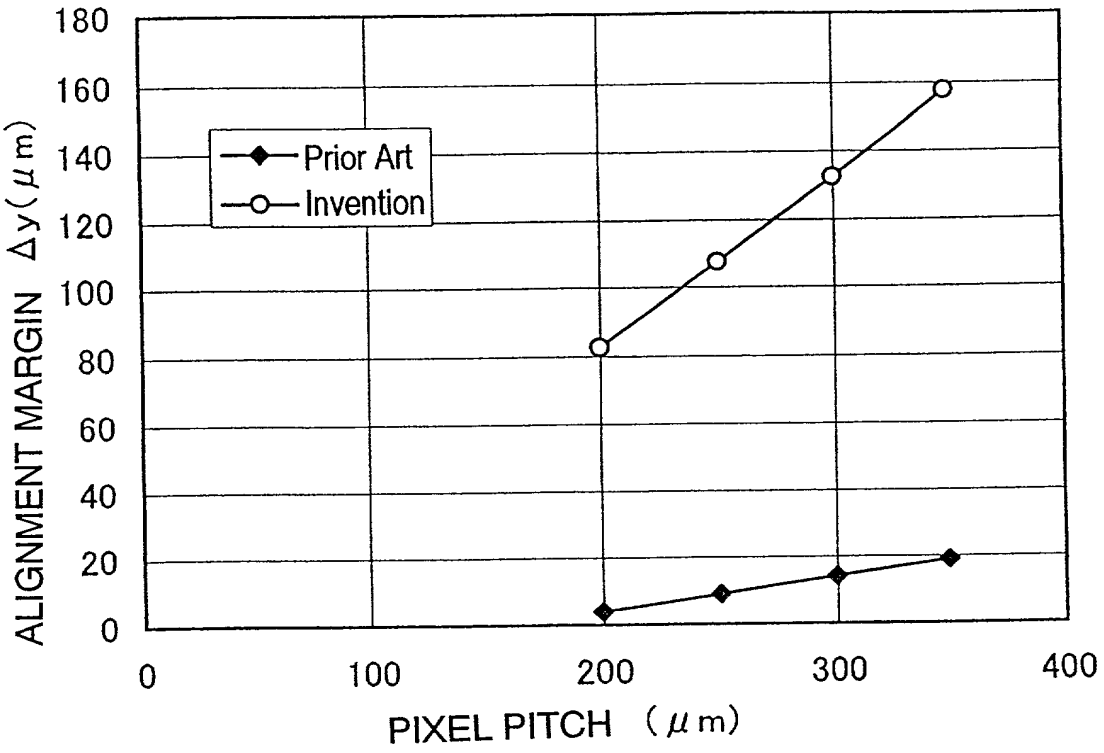
180
160
140
120
100
80
60
40
20
0
ALIGNMENT MARGIN Δy(μm)
Prior Art
Invention
0
100
200
300
400
PIXEL PITCH (μm)

FIG. 14

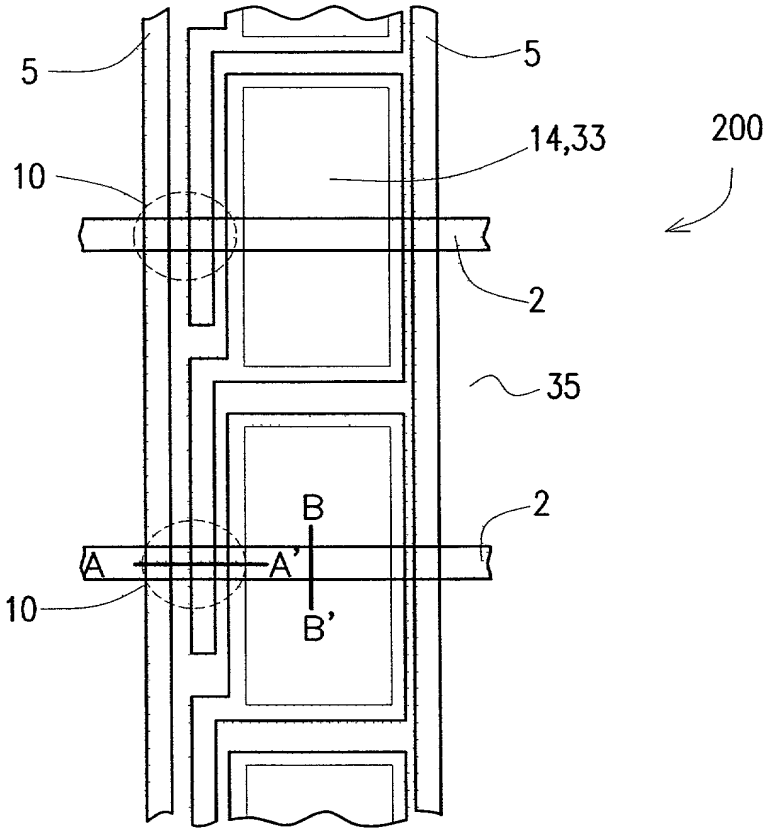

FIG. 15A

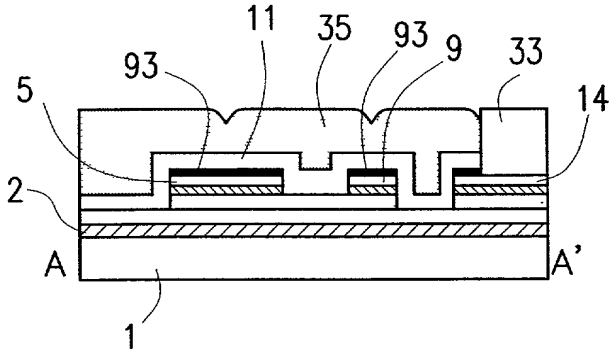

FIG. 15B

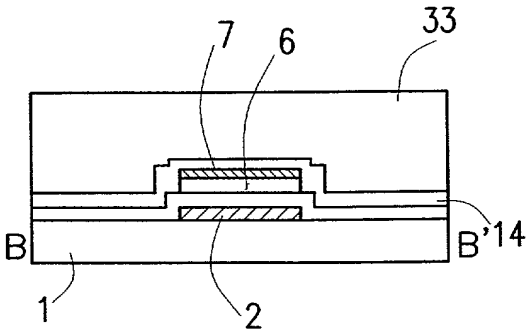

FIG. 16A

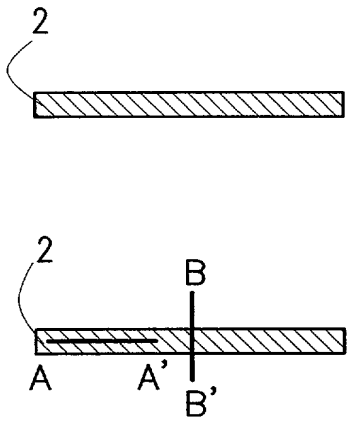

FIG. 16B

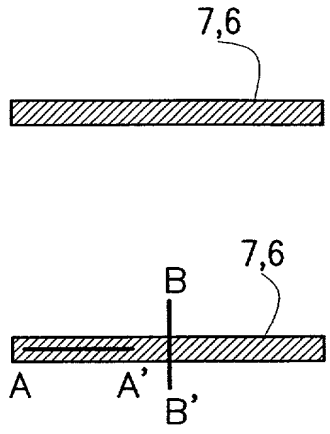

FIG. 16C

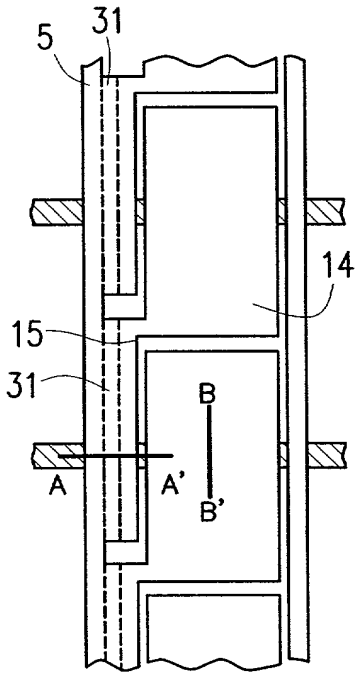

FIG. 16D

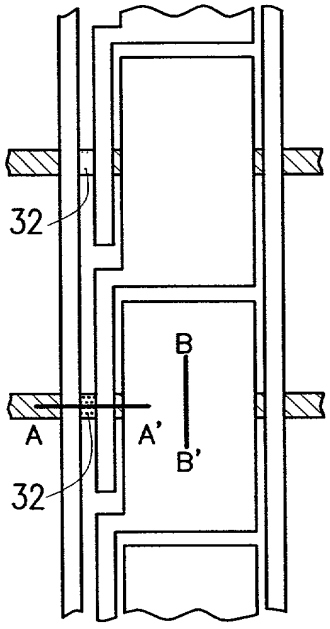

FIG. 16E

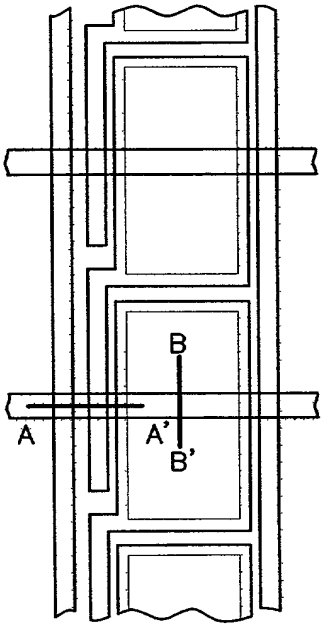

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FIG. 17A

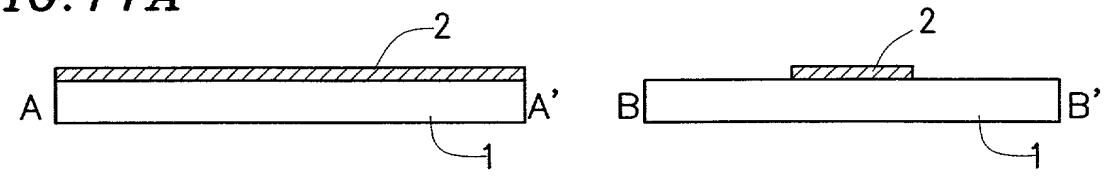

FIG. 17B

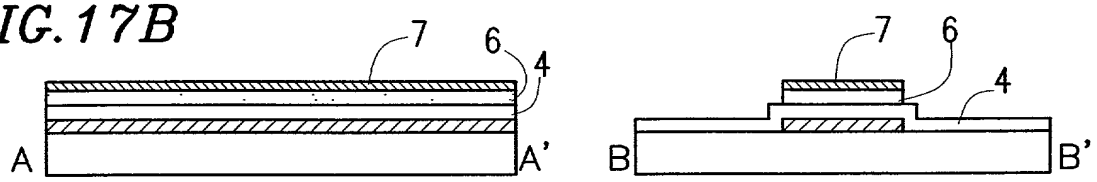

FIG. 17C

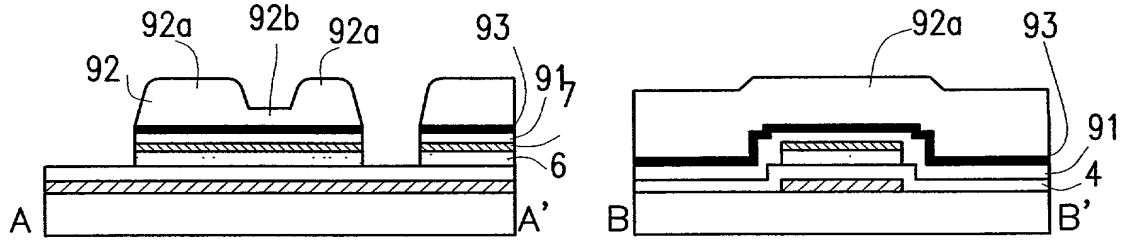

FIG. 17D

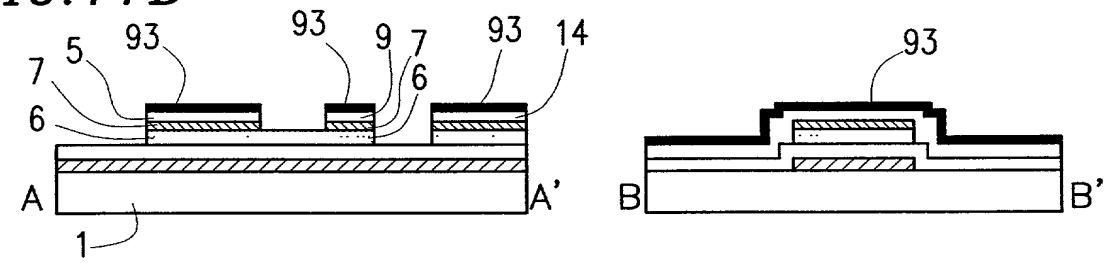

FIG. 17E

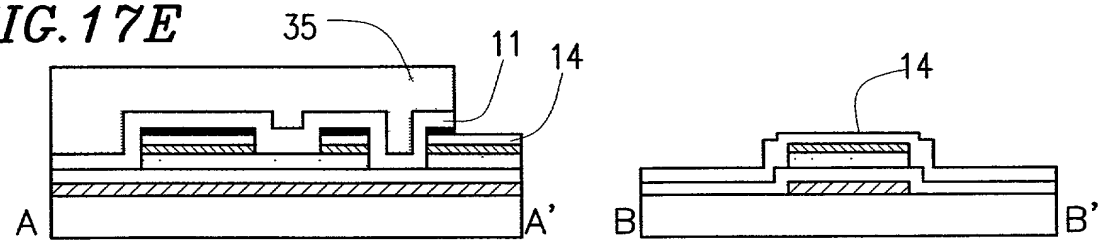

FIG. 17F

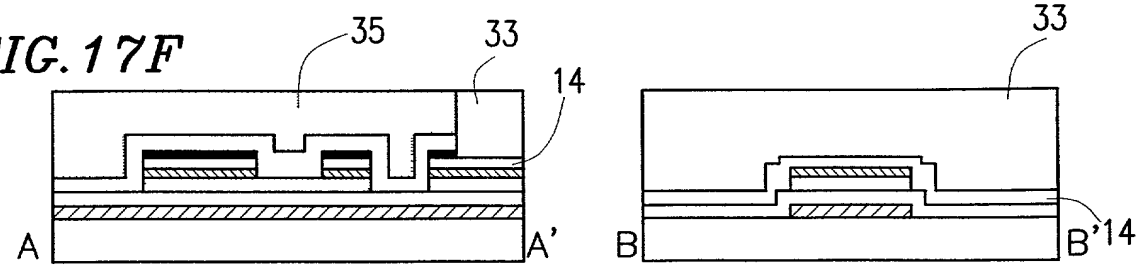

FIG. 18

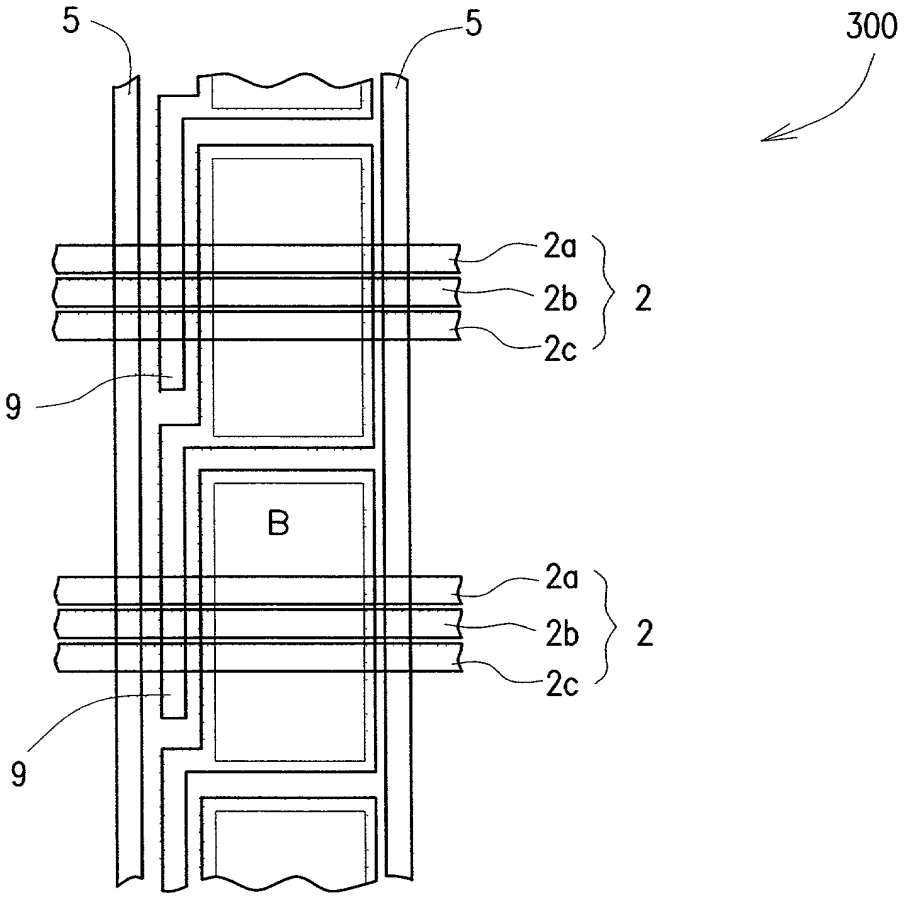

FIG. 19A

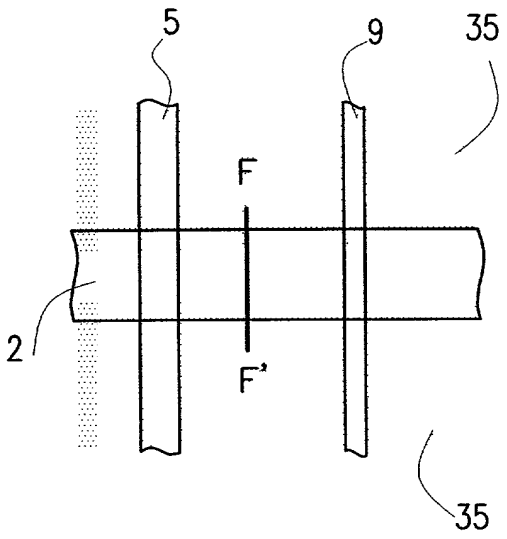

FIG. 19B

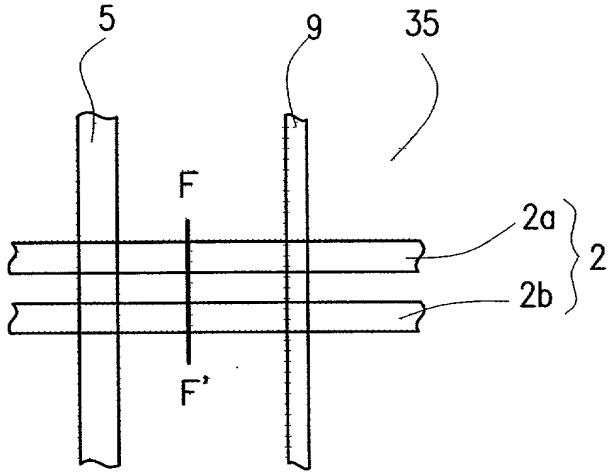

FIG. 19C

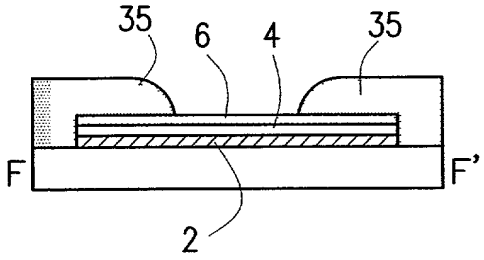

FIG. 19D

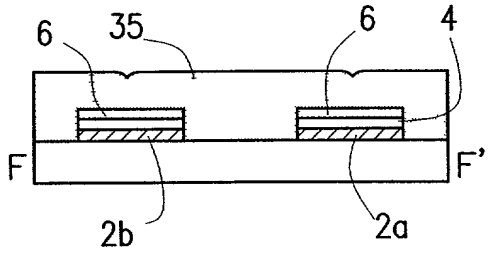

FIG.20A

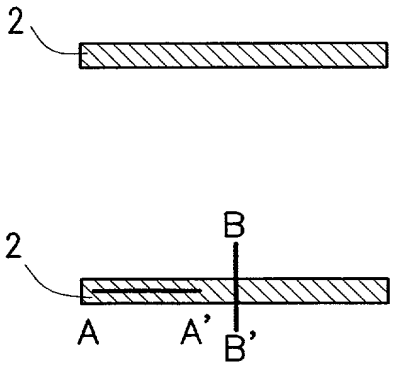

FIG.20B

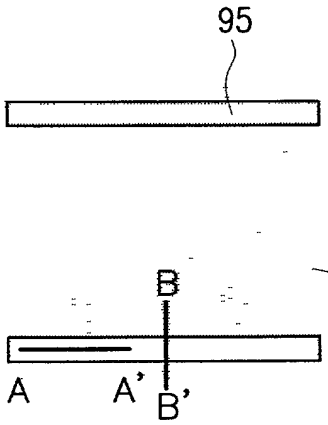

FIG.20C

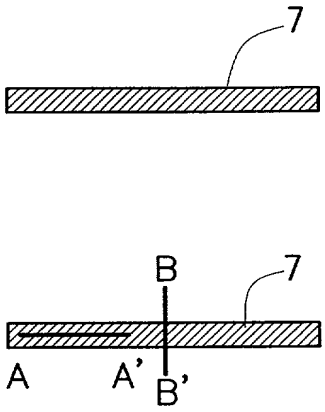

FIG.20D

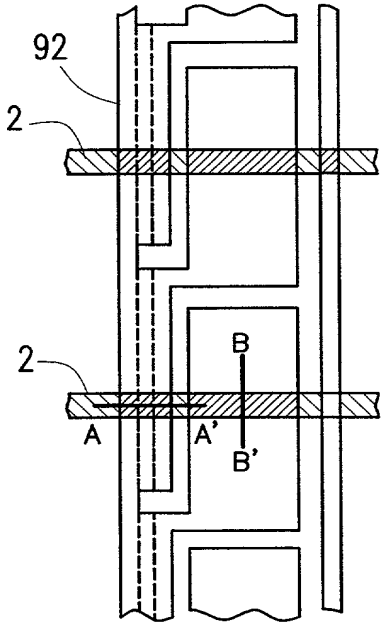

FIG.20E

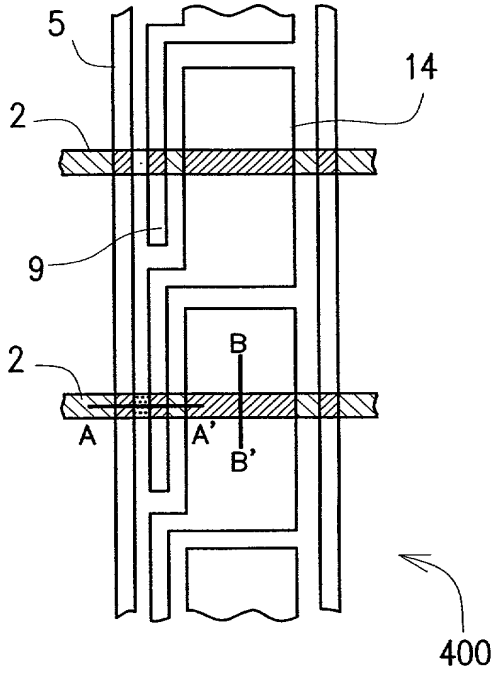

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FIG.21A

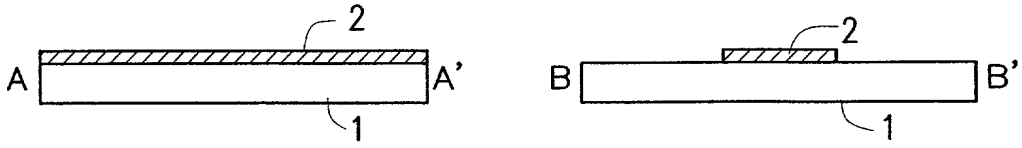


FIG.21B

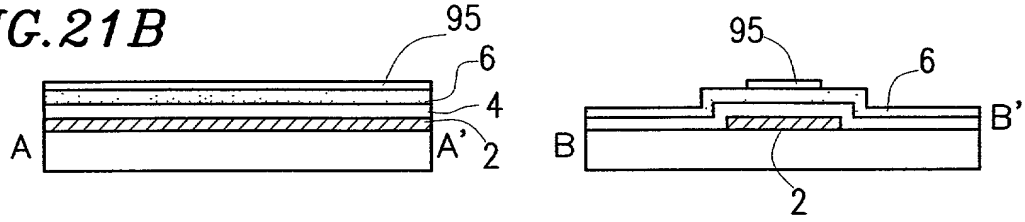


FIG.21C

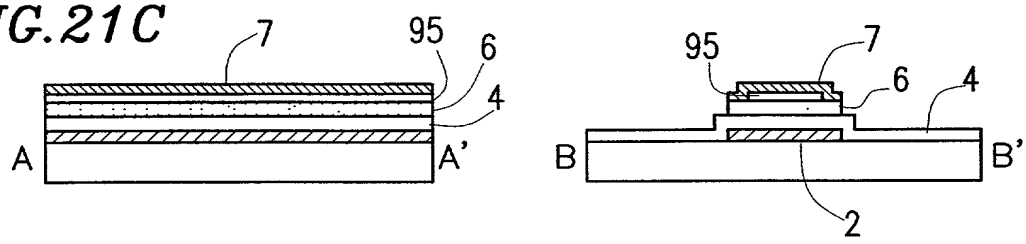


FIG.21D

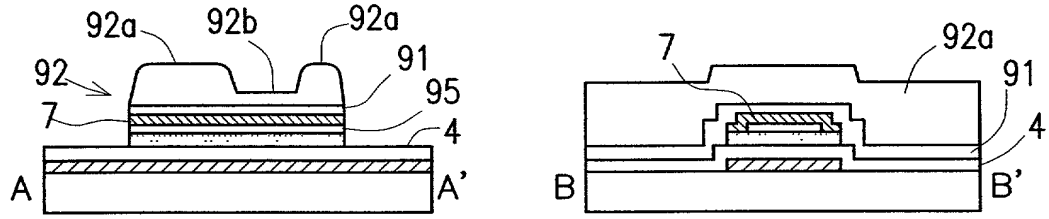


FIG.21E

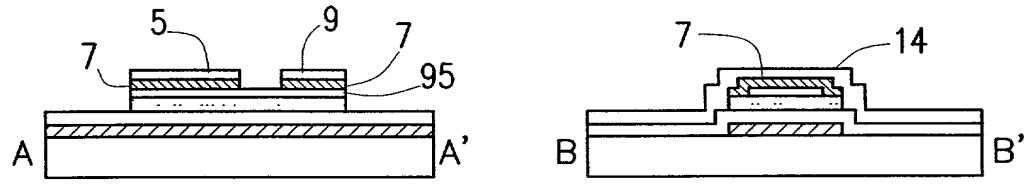


FIG.21F

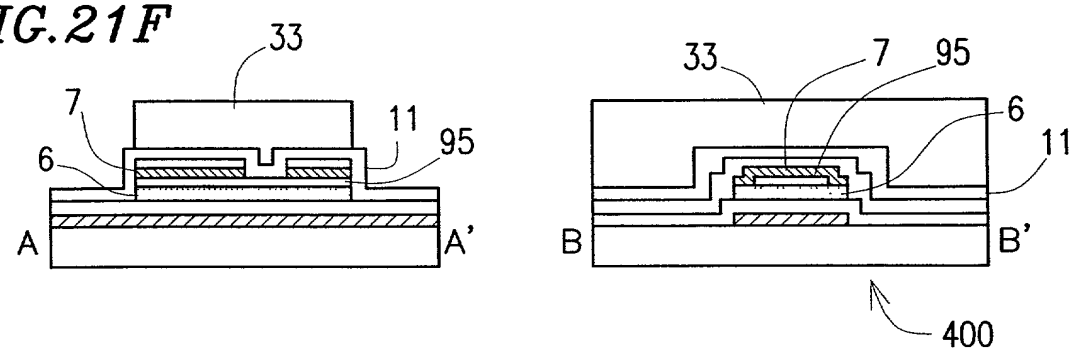


FIG.22

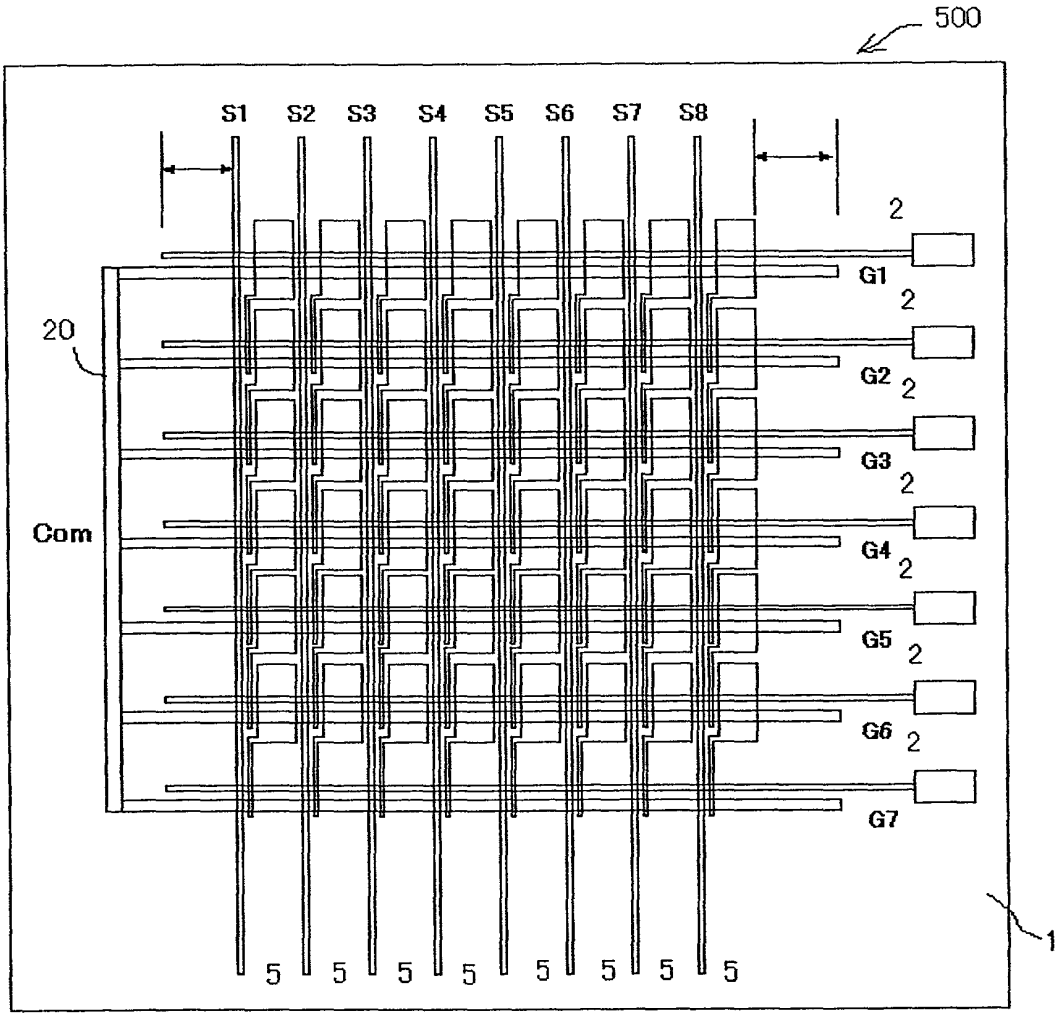


FIG.23

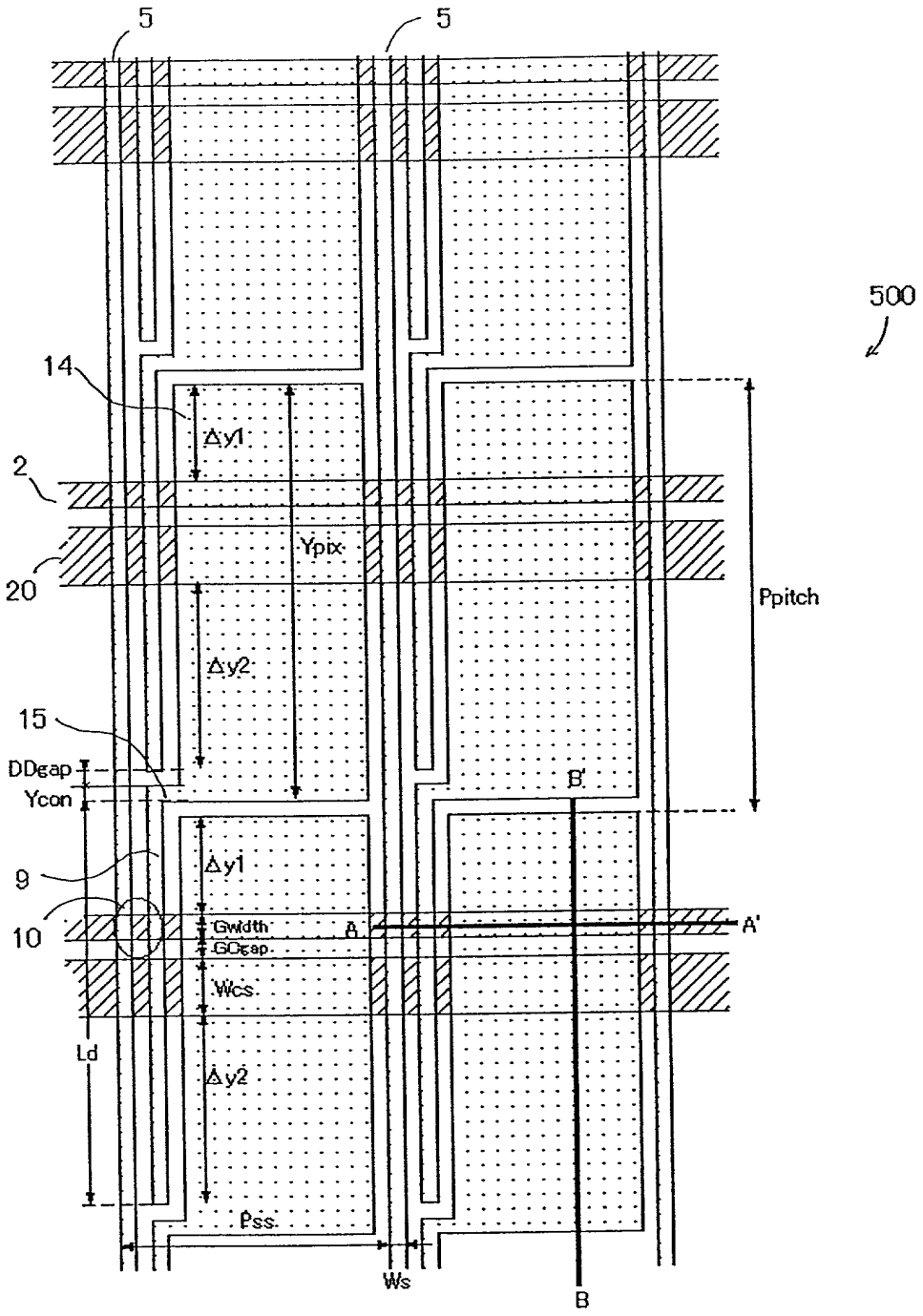

5
5
500
14
Δy1
2
Ypix
20
Ppitch
Δy2
15
DDgap
Ycon
B'
9
Δy1
10
Gwidth
A
A'
GDgap
Wcs
Ld
Δy2
Pss
Ws
B

FIG.24

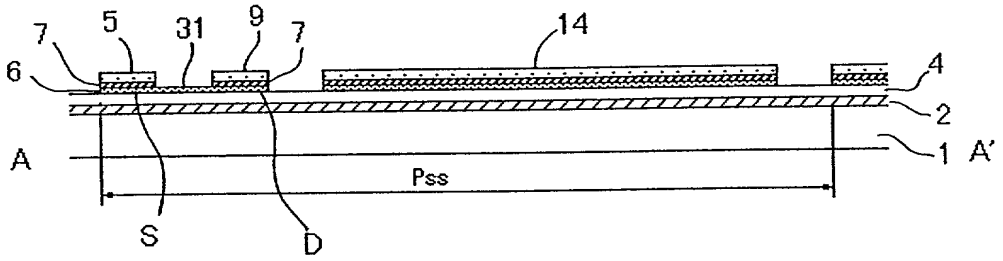
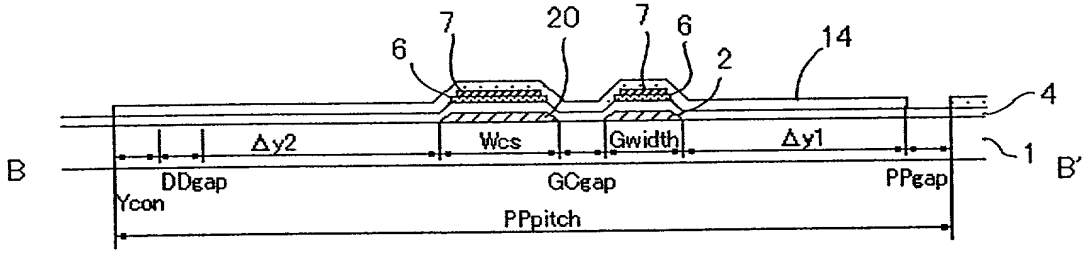


FIG.25



$$\Delta Y=\Delta y1+\Delta y2$$
$$=Ppitch-Gwidth-PPgap-Wcs-GCgap-DDgap-Ycon$$

FIG. 26

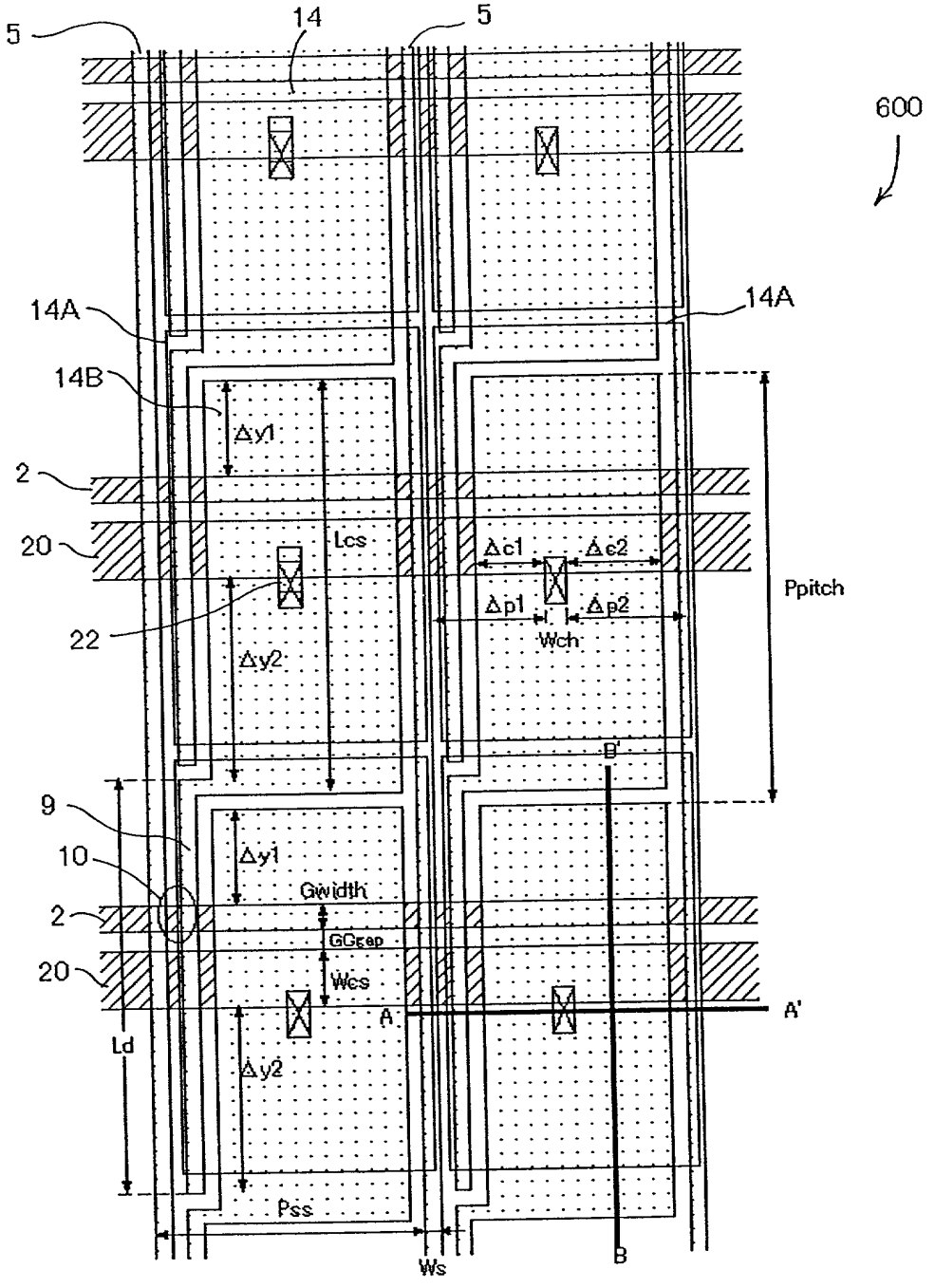
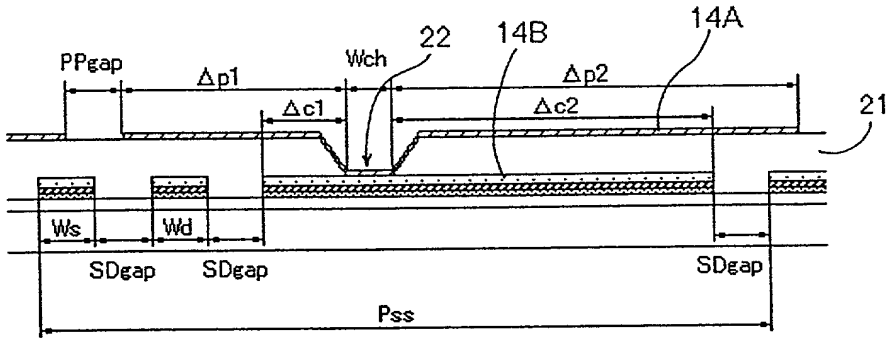

5
14
5
600
14A
14A
14B
Δy1
2
20
Lcs
Δc1
Δc2
Ppitch
Δp1
Δp2
22
Wch
Δy2
B'
9
10
Δy1
Gwidth
2
GGgap
20
Wcs
A
A'
Ld
Δy2
Pss
Ws
B

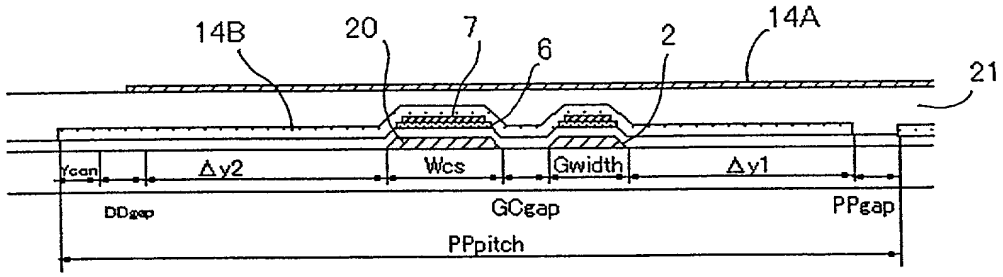
FIG.27



$$\Delta C = \Delta c1 + \Delta c2$$
$$= Pss - Ws - Wd - 3 \cdot SDgap - Wch$$

$$\Delta P = \Delta p1 + \Delta p2$$
$$= Pss - PPgap$$

FIG.28



$$\Delta Y = \Delta y1 + \Delta y2$$
$$= Ppitch - Gwidth - PPgap - Wcs - GCgap - DDgap - Ycon$$

FIG.29

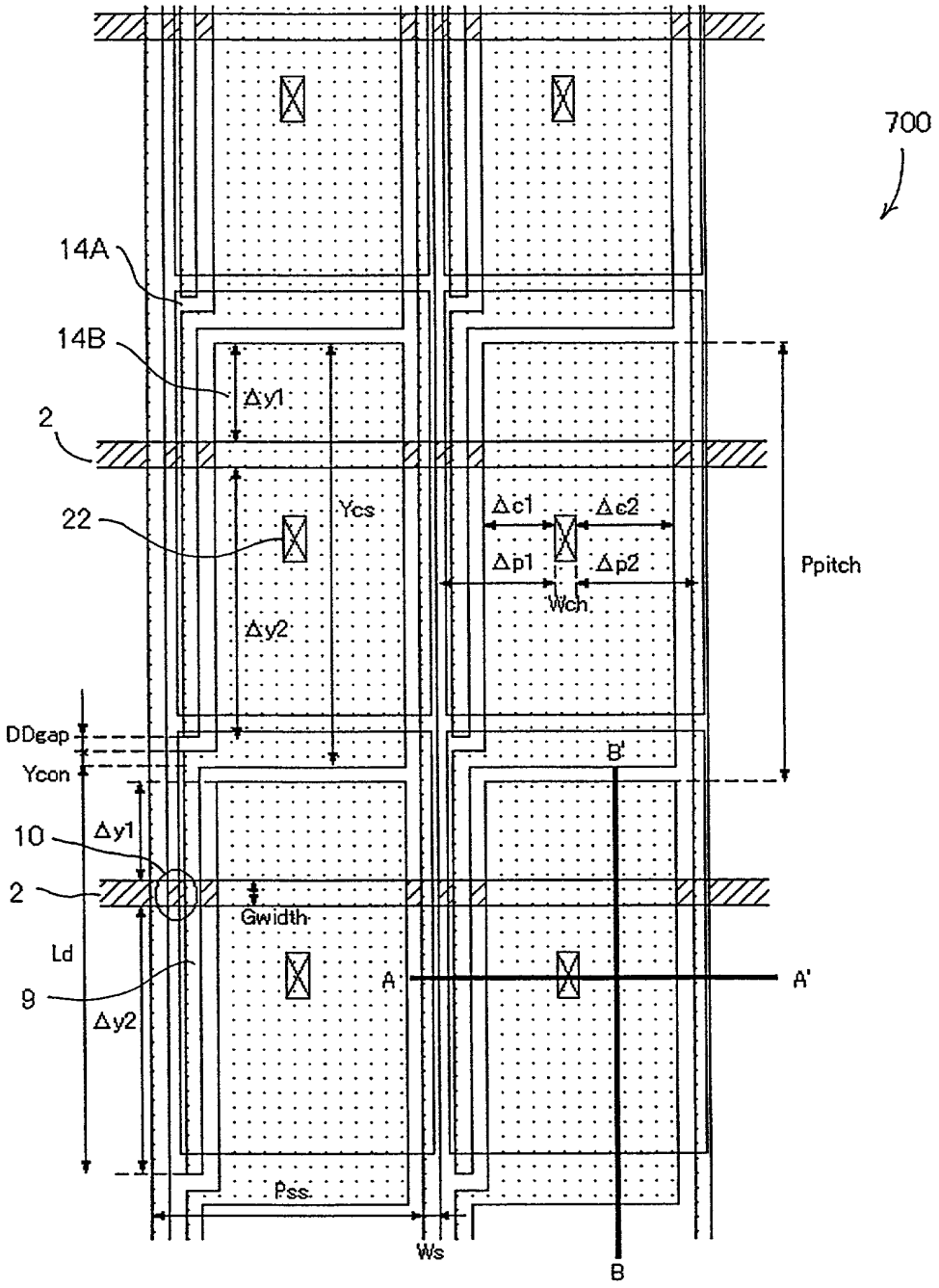
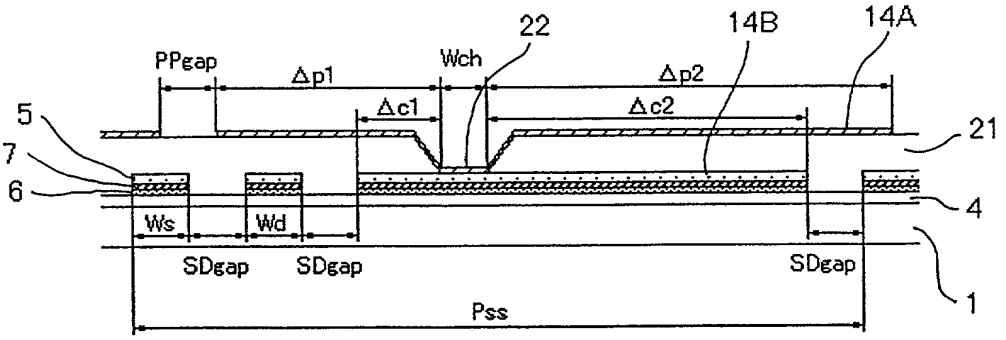

700
14A
14B
Δy1
2
22
Ycs
Δc1
Δc2
Δp1
Δp2
Wch
Ppitch
Δy2
DDgap
Ycon
B'
10
Δy1
2
Gwidth
Ld
9
Δy2
A
A'
Pss
Ws
B

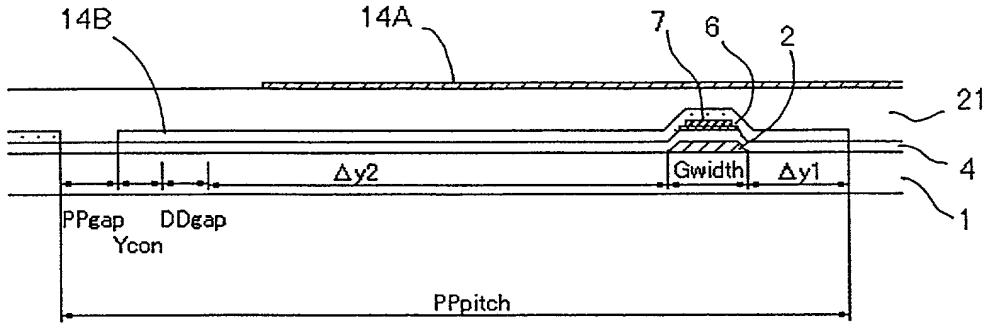
FIG.30



$$\Delta C = \Delta c1 + \Delta c2$$
$$= Pss - Ws - Wd - 3 \cdot SDgap - Wch$$

$$\Delta P = \Delta p1 + \Delta p2$$
$$= Pss - PPgap$$

FIG.31



$$\Delta Y = \Delta y1 + \Delta y2$$
$$= Ppitch - Gwidth - PPgap - DGgap - Ycon$$

FIG.32

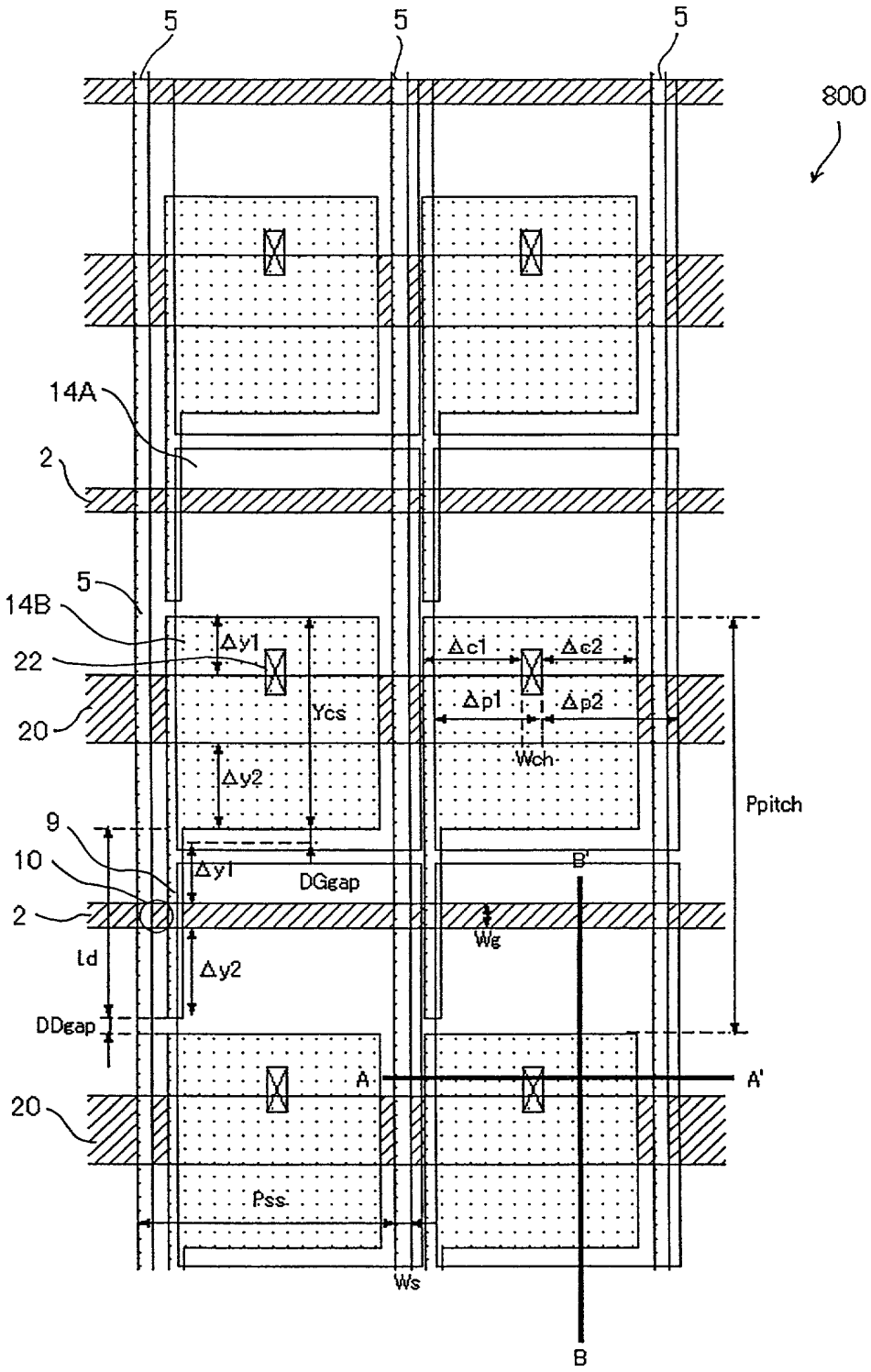
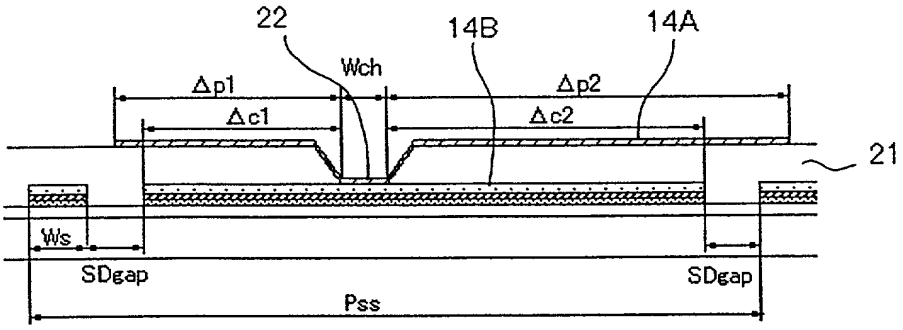

5
5
5
800
14A
2
5
14B
22
20
Δy1
Ycs
Δy2
Δc1
Δc2
Δp1
Δp2
Wch
Ppitch
9
10
2
Δy1
DGgap
B'
Wg
ld
Δy2
DDgap
A
A'
20
Pss
Ws
B

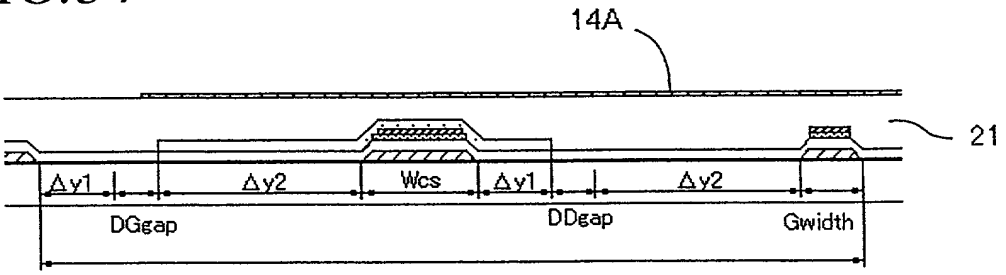
FIG.33



$$\Delta C = \Delta c1 + \Delta c2$$
$$= Pss - Ws - 2 \cdot SDgap - Wch$$

$$\Delta P = \Delta p1 + \Delta p2$$
$$= Pss - PPgap$$

FIG.34



$$\Delta Y = \Delta y1 + \Delta y2$$
$$= (Ppitch - Gwidth - Wcs - DDgap - DGgap)/2$$

FIG.35

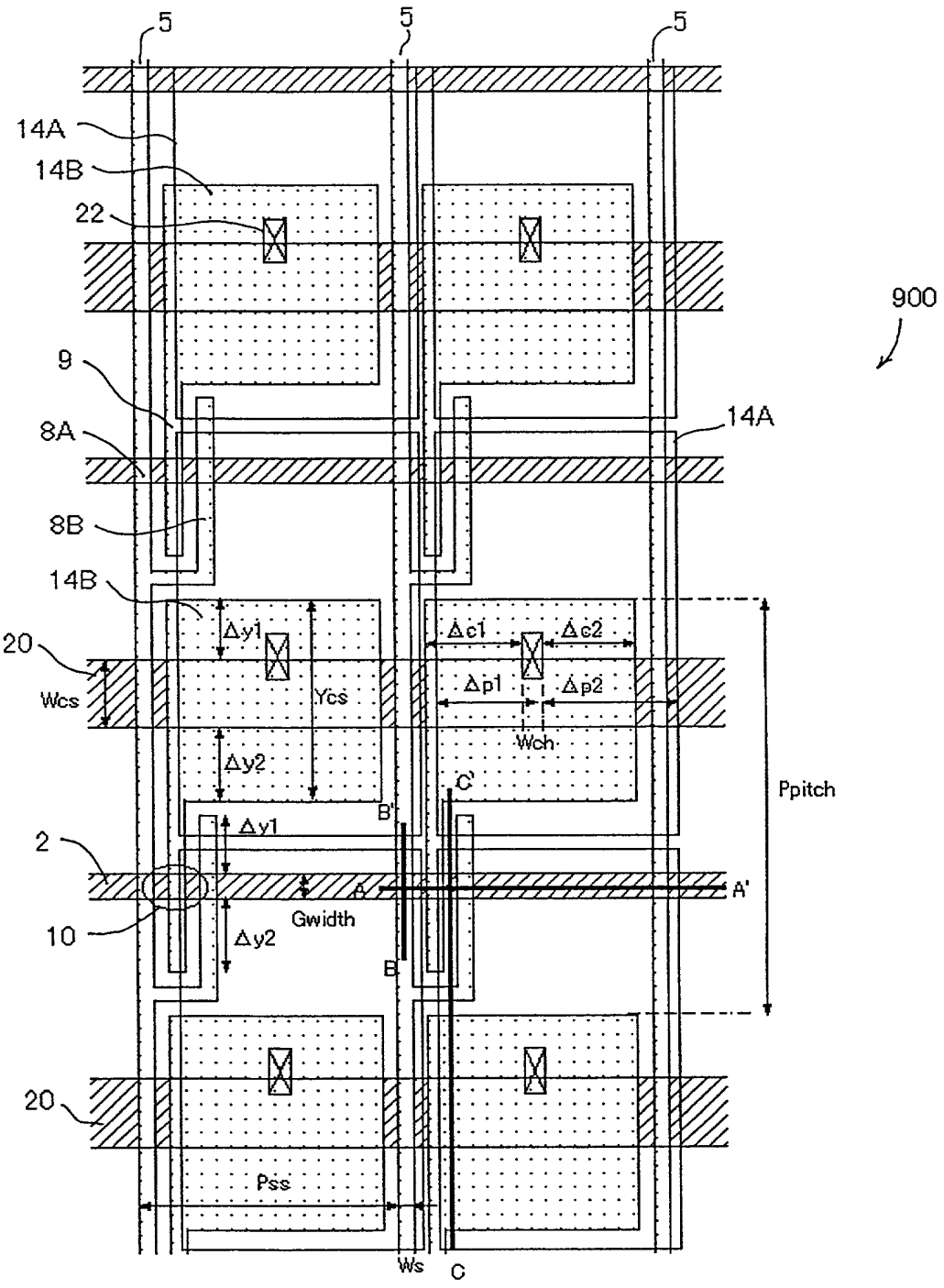

5
5
5
14A
14B
22
900
9
14A
8A
8B
14B
Δy1
Δc1
Δc2
20
Wcs
Ycs
Δp1
Δp2
Wch
Δy2
C'
Ppitch
B'
Δy1
2
A
A'
Gwidth
10
Δy2
B
20
Pss
Ws
C

FIG.36

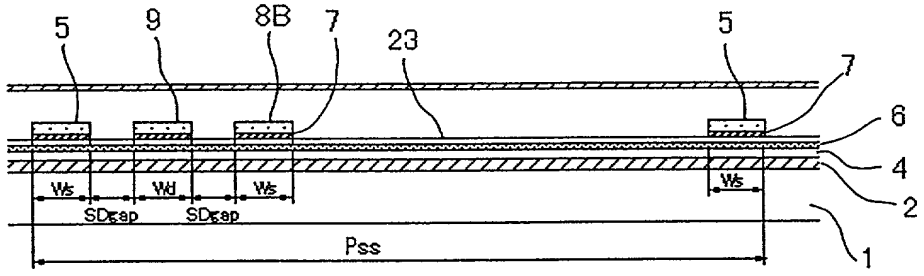


FIG.37

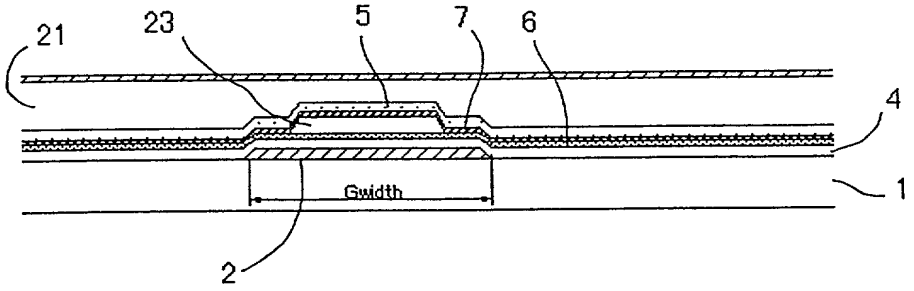
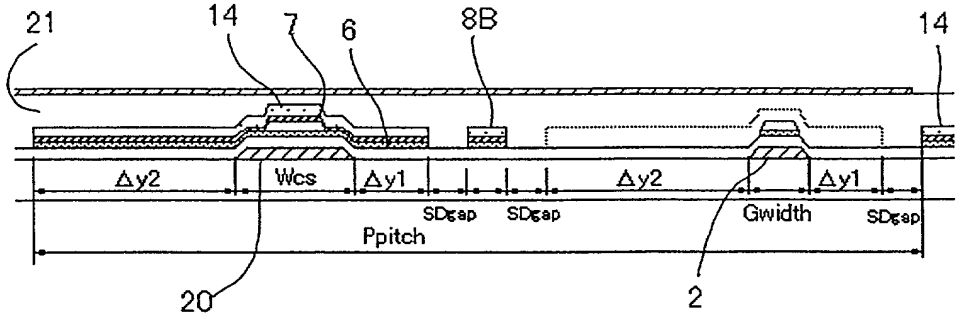


FIG.38



$$\Delta Y = \Delta y1 + \Delta y2$$
$$= (Ppitch - Gwidth - Wcs - Ws - 3 \cdot SDgap)/2$$

FIG.39

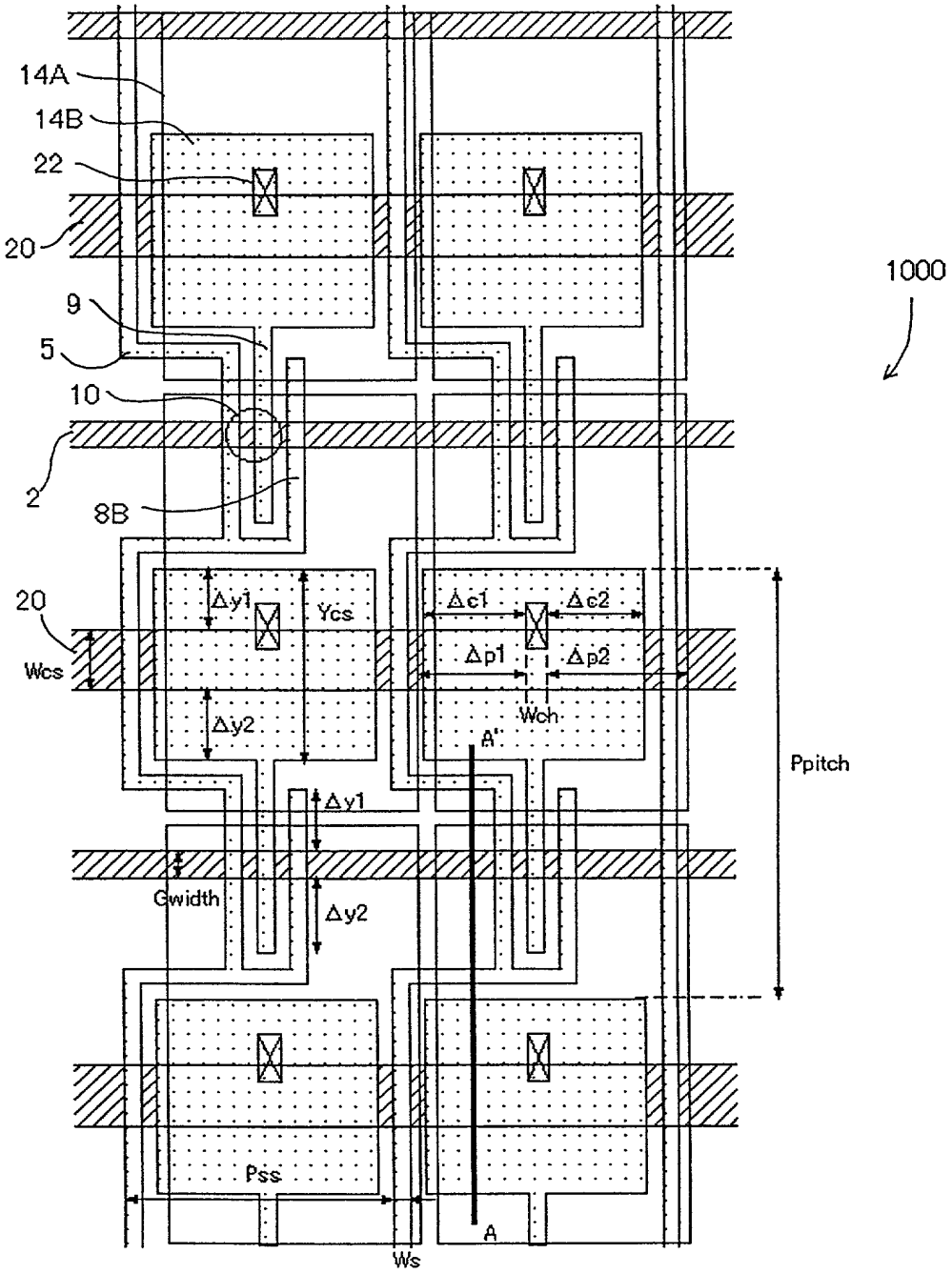
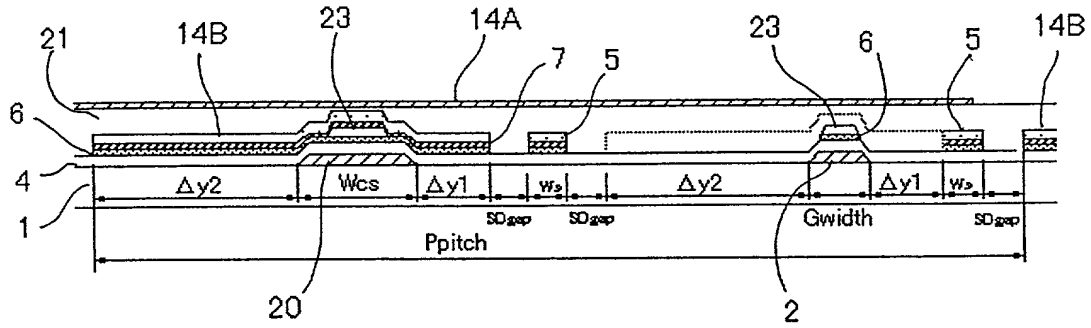

14A
14B
22
20
9
5
10
2
8B
20
Wcs
Δy1
Ycs
Δy2
Δy1
Gwidth
Δy2
Pss
Ws
Δc1
Δc2
Δp1
Δp2
Wch
A'
A
Ppitch
1000

FIG.40



$$\Delta Y = \Delta y1 + \Delta y2$$
$$= (Ppitch - Gwidth - Wcs - 2 \cdot Ws - 3 \cdot SDgap)/2$$

FIG. 41A

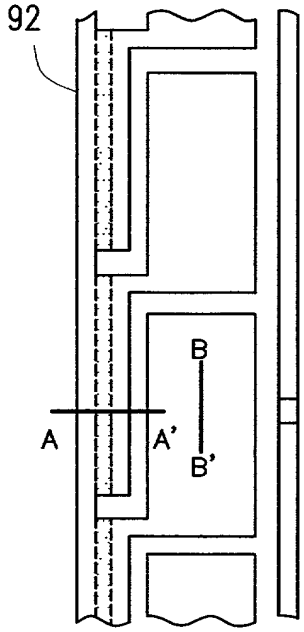


FIG. 41B

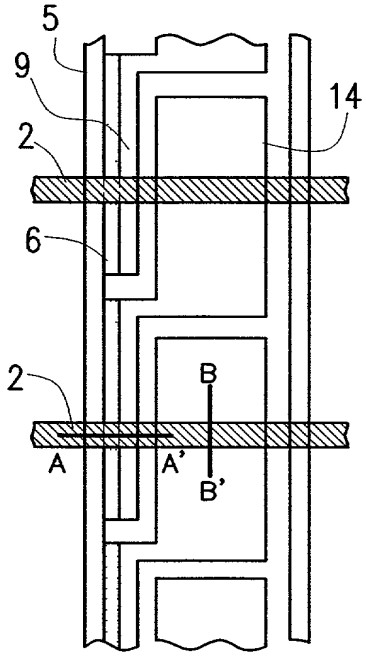


FIG. 41C

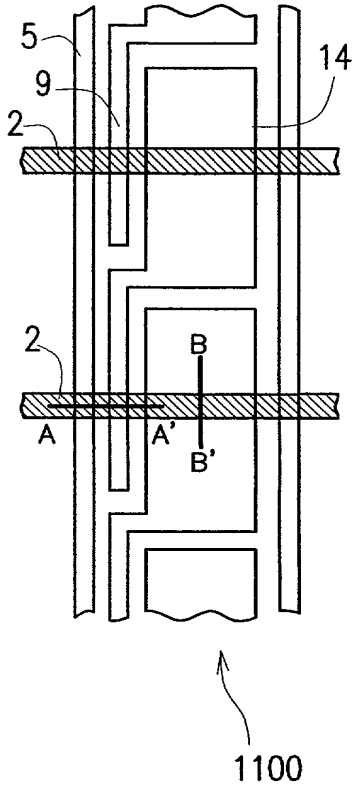


FIG. 42A

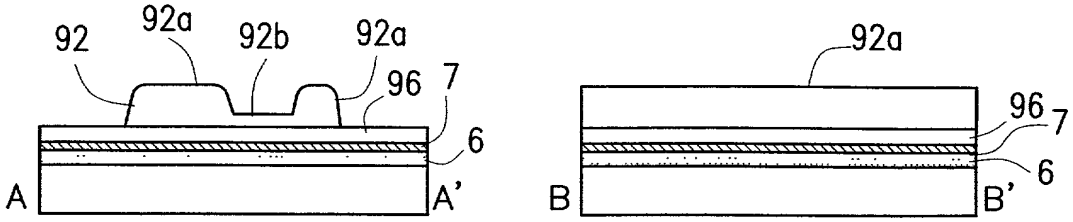


FIG. 42B

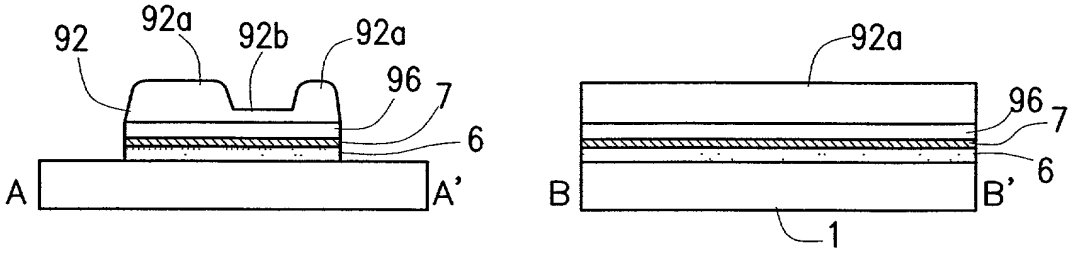


FIG. 42C

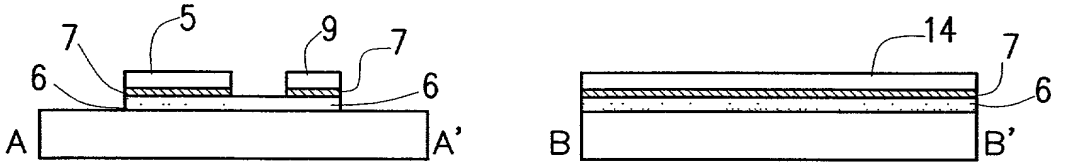


FIG. 42D

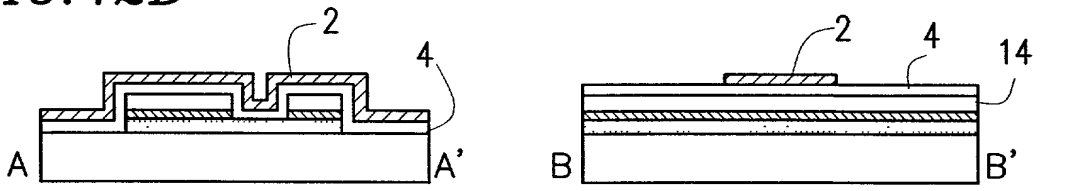


FIG. 42E

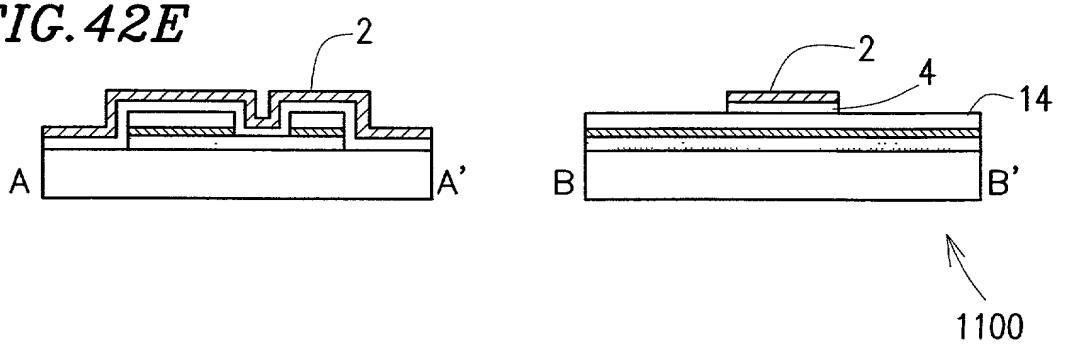


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FIG. 43

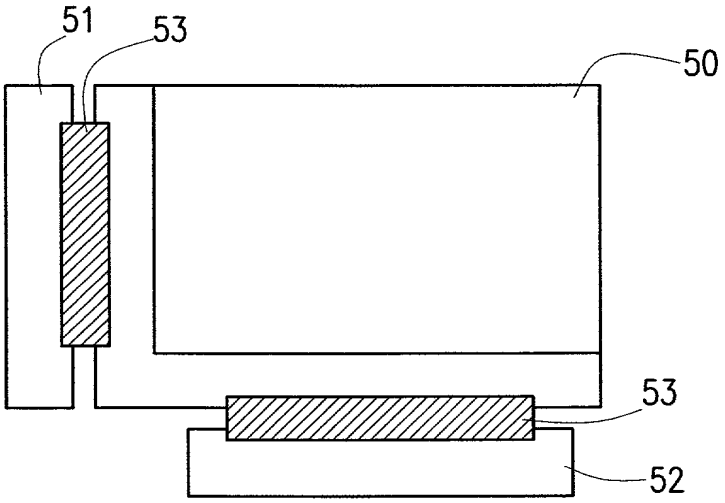


FIG. 44

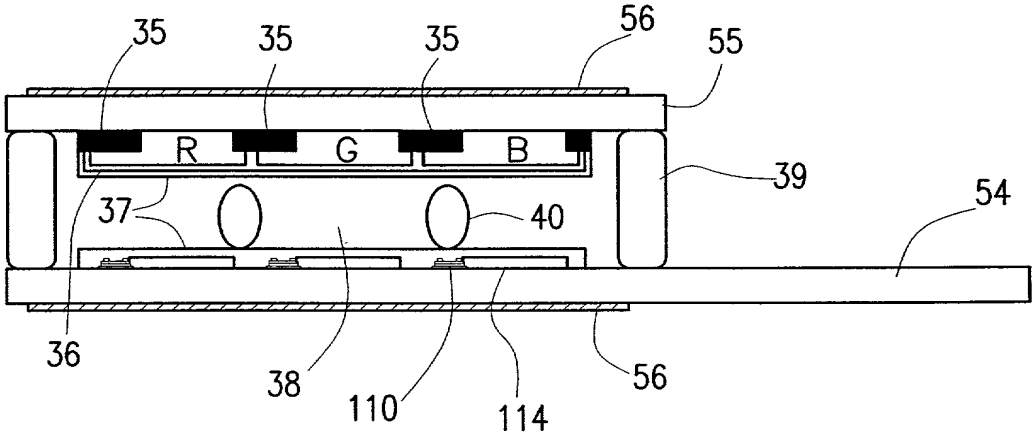


FIG. 45A

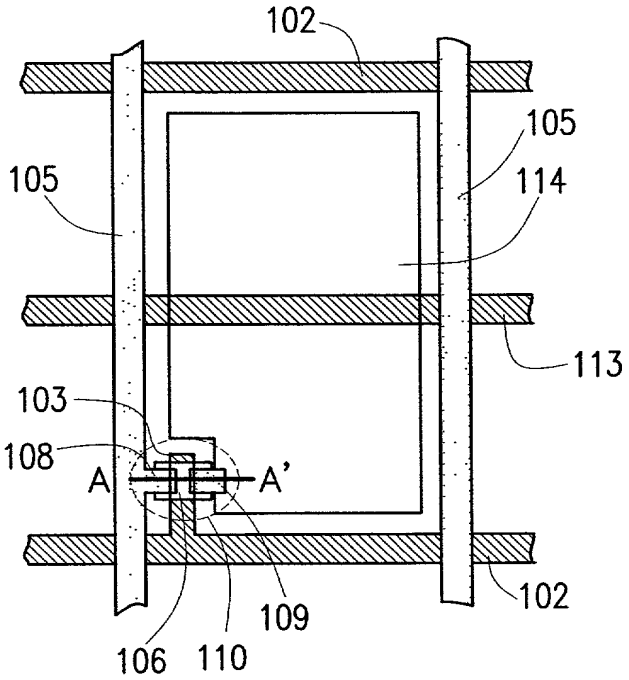


FIG. 45B

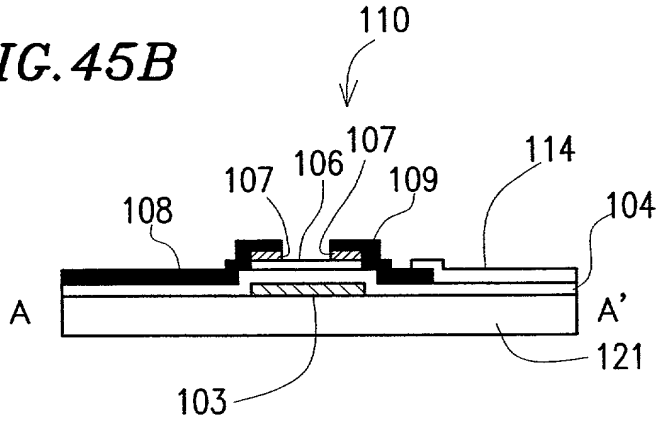


FIG. 46A

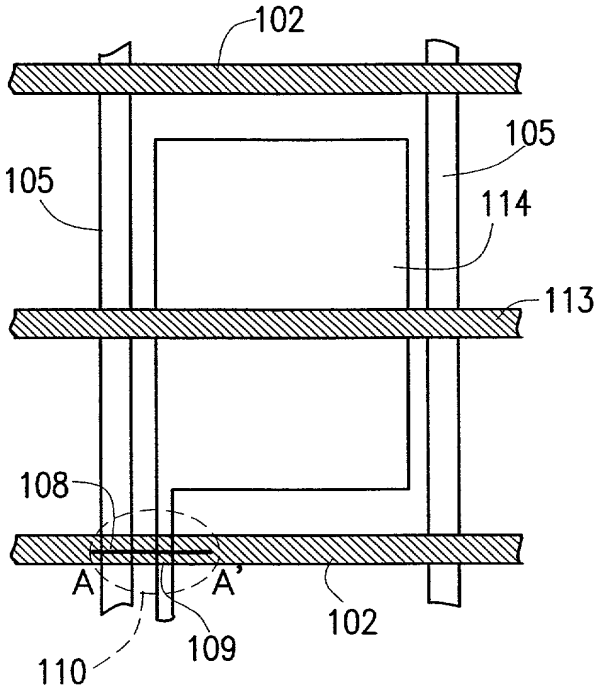


FIG. 46B

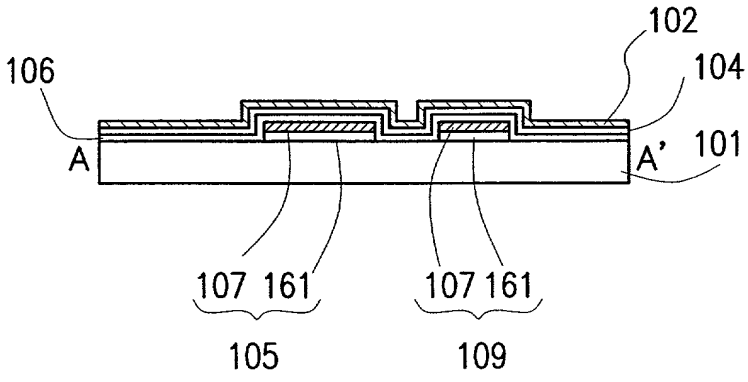


FIG. 47

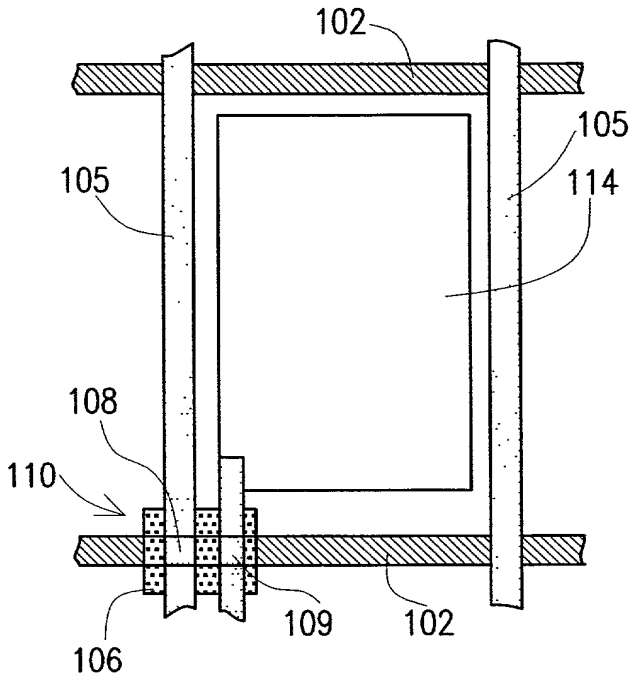
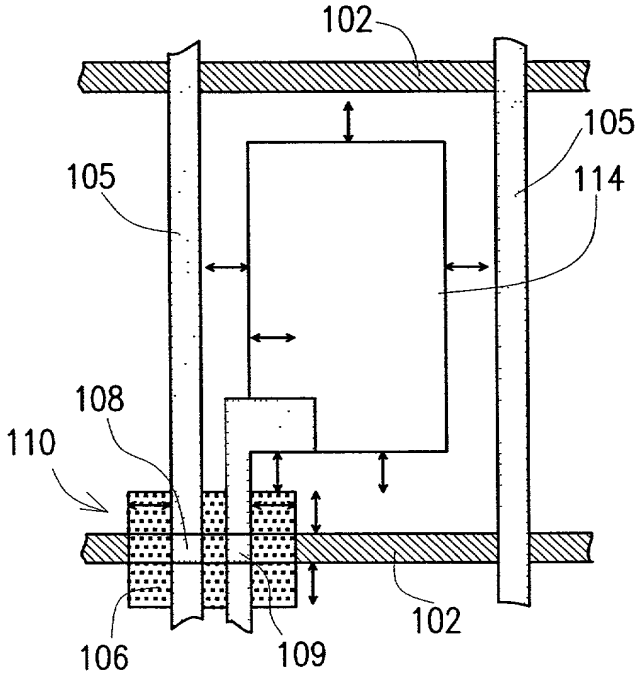

102
105
105
114
108
110
109
102
106

FIG. 48


102
105
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114
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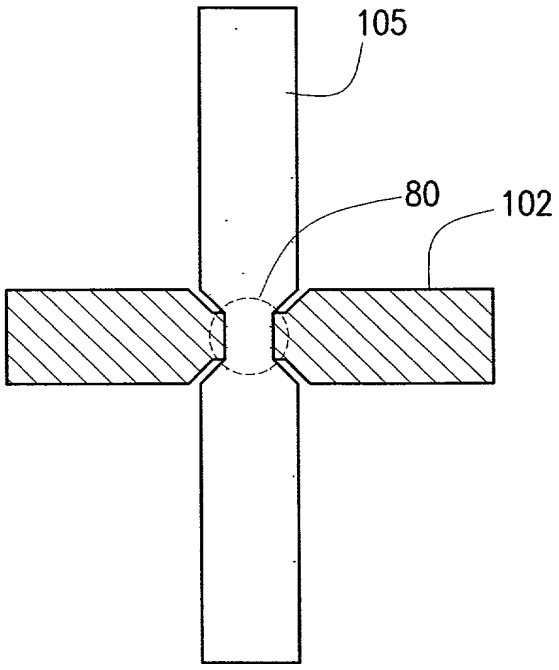
FIG. 49